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ABSTRACT

This project attempted to develop a baseline on which the community could assess its own local environment. The objectives of the study include developing a list of references and resources, developing an assessment model for community use, composing an environmental quality index, determining areas to be protected and persuading decision-making bodies to proper land management, involving college and community groups in a cooperative effort, recommending and providing guidelines for future studies, and publishing results for public use. Eight subprojects were completed combining the social and natural elements of the community. The study areas defined were historical survey, attitude assessment, botanical analysis, macro-invertebrates study, fish life study, wildlife analysis, solid waste analysis, and population analysis. (MR)

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GREENWICH TOWNSHIP

ENVIRONMENTAL ANALYSIS

A Field Study 1972 - 74

Funded by

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PREFACE

The Greenwich Township Environmental Analysis (GTEA) was an outgrowth of the recent surge in public concern for environmental quality. One significant result of numerous public and legal battles regarding use of land, water, and other natural resources has been the realization that no effective system exists by which the concerned public can take a direct hand in assessing the value of large segments of the environment. Therefore, in a cooperative effort involving the Pennsylvania Ecological Consortium, headquartered at West Chester State College, West Chester, Pa.; Kutztown State College, Kutztown, Pa.; and the Gifford Pinchot Group of the Sierra Club, Lenhartsville, Pa., the Greenwich Township Environmental Analysis project was initiated. One basic objective of this effort was to undertake the assessment of the state of the environment in Greenwich Township, Berks County, Pennsylvania.

Funds for the project were provided by the Pennsylvania Ecological Consortium under the Higher Education Act of 1965; Title I - Community Service and Continuing Education Programs. Kutztown State College provided a "base of operations." The Gifford Pinchot Group of the Sierra Club provided local public service-group input.

After numerous meetings between Dr. LeRoy Schuette, Director of the Ecology Project at West Chester State College for the Pennsylvania Ecological Consortium, and Dr. Robert B. Brumbaugh, Director of Research at Kutztown State College, the first project director, Mr. Ronald Rhein, Associate Professor of Biology at Kutztown State College was appointed. Mr. Rhein formally began the organization of the GTEA team in September, 1972.

Under Mr. Rhein's leadership the basic outline for the GTEA project was formed and ten research subprojects created. In turn, the ten subprojects were undertaken by representatives of the Sierra Club; Kutztown State College; Cedar Crest College, Allentown, Pa.; Muhlenberg College, Allentown, Pa.; and Hawk Mountain Sanctuary, Kempton, Pa.

When Professor Rhein became Assistant Dean of Liberal Arts and Sciences at Kutztown State College in September, 1973, he relinquished project leadership to Dr. Albert Dixon, of the Political Science Department at Kutztown. Dr. Dixon subsequently relinquished the project to Dr. J. Wesley Bahorik, Associate Professor of Biology at Kutztown, in May, 1974.

Of the original ten subprojects, seven were completed by September, 1974, as follows: two reports under Aquatic Analysis - "A Study of the Invertebrates in the Sacony and Maiden Creeks," by James Brett, Hawk Mountain Sanctuary, and, "A Study of Fish Life," by Dr. J. Wesley Bahorik, Department of Biology, Kutztown State College; Wildlife Analysis by Dr. Carl Oplinger, Department of Biology at Muhlenberg College and Mr. Robert Gray, Department of Biology at Kutztown State College; Botanical Analysis by Professor J. Robert Halma, et. al., of the Department of Biology at Cedar Crest College; Historical-Economic Analysis by Dr. Priscilla Atwell, Department of History at Kutztown State College; Political Analysis by Dr. Albert Dixon, Department of Political Science at Kutztown State College; Solid Waste Disposal by Mr. Tom Schmoyer, representing the Sierra Club; and Population Analysis by Mr. Patrick Duddy, Department of Biology at Kutztown State College.

Although the project was beset by weather difficulties (as in any field work) and a tripartite directorship, we have seen a successful completion and fulfillment of the original project goals (see Introduction). Therefore, considerable thanks are due to the following persons and institutions: To the Pennsylvania Ecological Consortium, especially Dr. LeRoy Schuette, Director Ecology Project;

at West Chester State College for providing funds for the project; to Dr. Robert B. Brumbaugh, Director of Research at Kutztown State College, who spent large amounts of both his professional and personal (vacation) time in aid to and consultation with directors and serving as general project "watch dog" during the prject's entire course; to Kutztown State College for providing office space for the project, and additional necessary material and technical support; to Dr. Fina and Steve Spencer at the Kutztown State College Television Services for their assistance in the printing of this final report and production of T.V. tape for this study; to the Gifford Pinchot Group of the Sierra Club for supplying necessary citizen's group component and input to the project; to all of the researchers and writers who contributed massive amounts of their time and expertise to the project; and, finally, but definitely not last in importance, thanks to the concerned, cooperative residents of Greenwich Township, who very patiently tolerated researchers walking their land, asking questions, and filling their postal boxes with numerous items of correspondence.

It is the sincere hope of the entire GTEA team that this project will serve as a pilot or model for more and better work in the increasingly vital role of public decision-making regarding our national heritage.

A cautionary note to the reader: the reports recorded in this publication were carefully compiled by the research team. However, numerous areas of study require much more work. This is not due to negligence by an researchers. Rather, all team members were somewhat hampered by the established goals for the GTEA analysis. One of the most useful goals (see Introduction), the design to utilize and/or develop only techniques available and useable by the layman, proved to be the most limiting to the research effort. Much data obtainable by remote sensing (using infra-red spectrum analysis) electrofishing, aerial photography, seismographic recording, etc., could not be included in this study since the "man on the street" does not have ready access to these devices. The net effect of this limitation on technique leads some of the researchers to suggest that their studies are relatively incomplete and additional work is required prior to the formulation of concrete conclusions. Thus, we respectfully request our readers to accept these studies as the best available at this point in time. In general, these studies represent a series of direction indicators serving as a guide for those who desire to carry on future work in Greenwich Township, and, especially as indicators of direction for future study by those who have the decision-making responsibility which will forge the future of Greenwich Township.

A note on conclusions: The summary section appearing at the end of this publication reflects primarily a summative effort and opinion of the editor. Therefore, in order to obtain a complete concept of the status of the environment in Greenwich Township as described in this report, the reader should carefully read each study and weigh the data, conclusions, and recommendations of each individual author.

J. Wesley Bahorik

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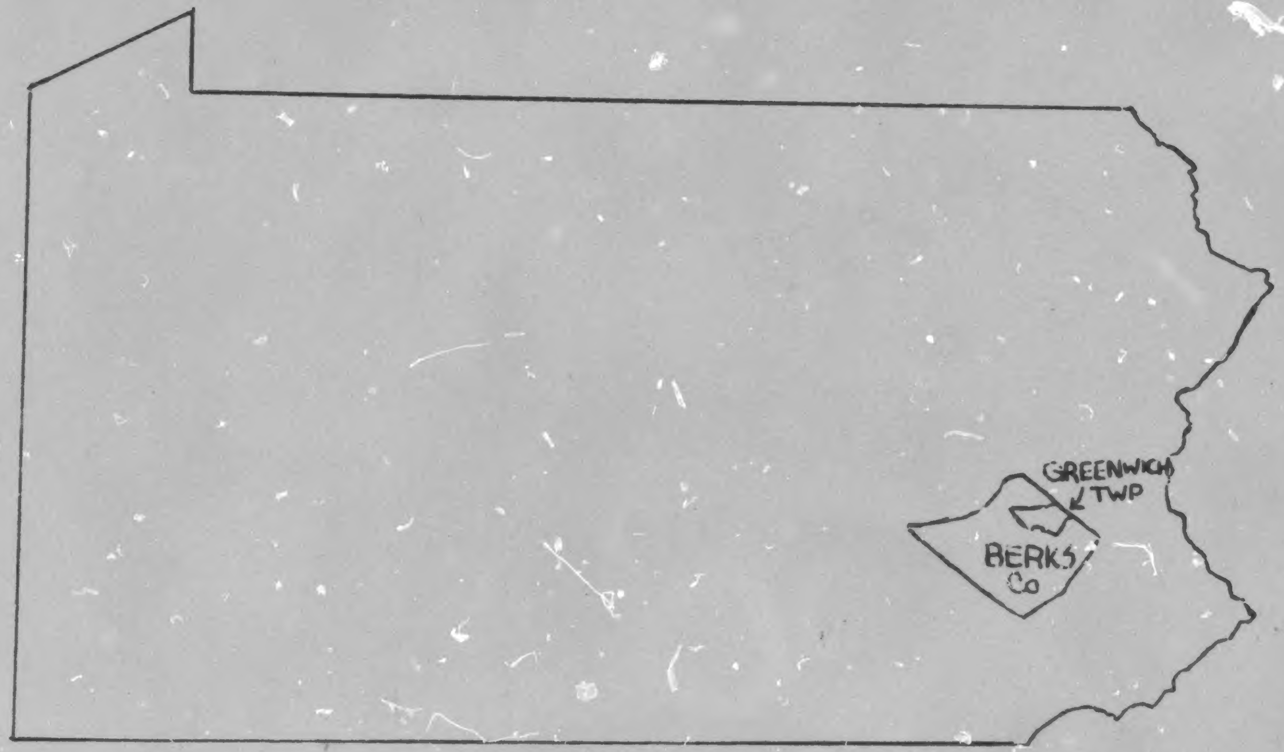
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Figure 1. Location of Greenwich Township

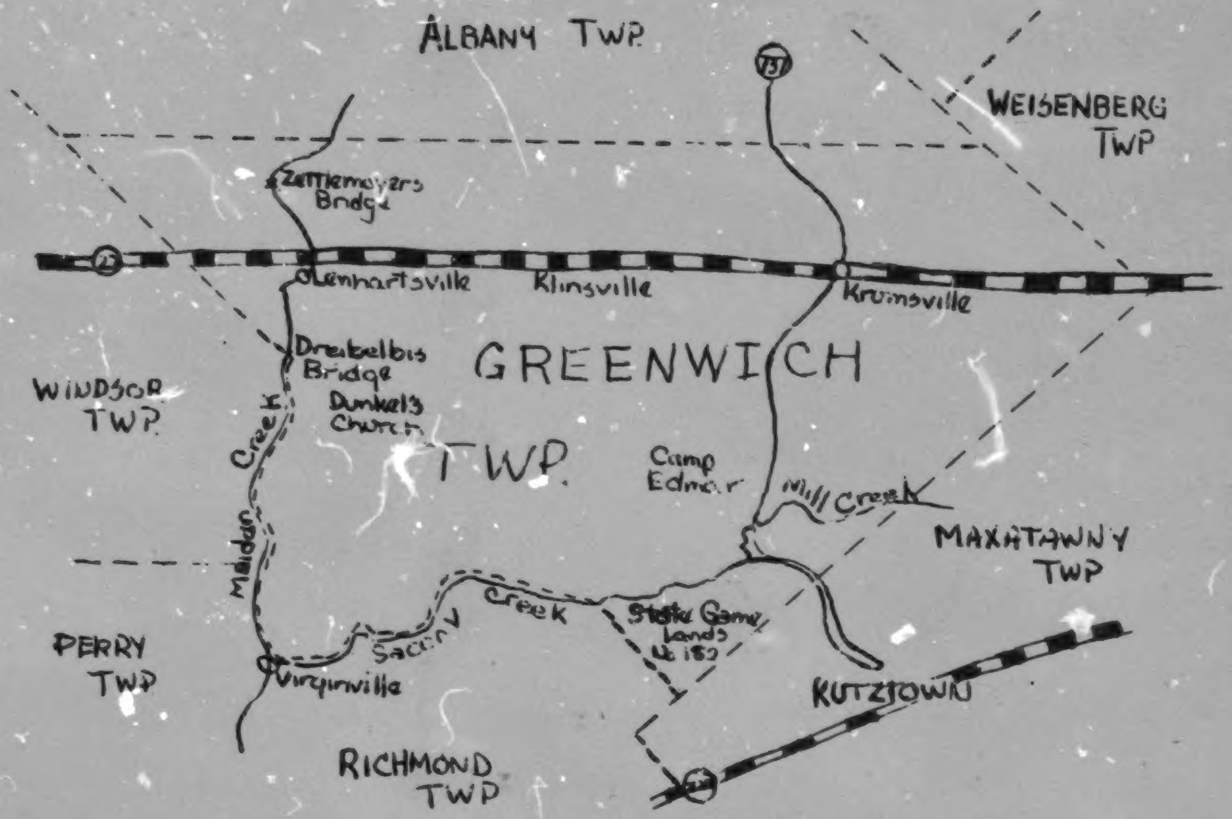
ALBANY TWP.
737
WEISENBERG TWP
Zettlemoyers Bridge
22
Lenhartsville
Klinsville
Krumsville
Dreibelbis Bridge
GREENWICH TWP.
WINDSOR TWP.
Dunkel's Church
Maiden Creek
Camp Edmar
Mill Creek
MAXATAWNY TWP
Saccony Creek
State Game Lands No 182
PERRY TWP
Virginville
KUTZTOWN
RICHMOND TWP
N
S

Figure 2. Some Features of Greenwich Township

INTRODUCTION

In the face of powerful public outcry against flagrant misuse of natural resources and frightening erosion of national culture, numerous individuals, institutions (public and private), municipalities, and citizen's groups launched, in the 1960's and early 1970's, a myriad of projects, legal actions, and publicity campaigns - all directed at conserving, protecting, or at least, questioning the use of our national and cultural heritage.

Some of these efforts have been successful, some have failed, some were vital, some were unnecessary emotional reactions to foundless crises. However, in all cases important lessons were learned. Among these lessons resides the important principle that all things, phenomena, and processes in nature, including man's activities, are inextricably intertwined such that no single effort to conserve or utilize a natural or cultural resource is totally independent.

Closely related to the principal that nothing can stand unique, isolated from its surroundings, was the realization that the rightfully aroused citizen did not have at his ready disposal the techniques, procedures, and guidance by which he could accurately assess the status of his environment.

Growing pressures for the citizen to make decisions regarding land, water, and air far outstripped the availability of necessary environmental data, especially data related to large natural areas and large political units (such as an entire city, region, township, county, river system, etc.).

This is not to say that such data do not exist. Numerous environmental scientists and research institutions regularly collect valuable data. However, these data are usually in highly technical form and, moreover, the techniques employed in obtaining such data are beyond the reach of the average citizen. Yet, it is the average citizen who must make decisions as to the future of his block, his farm, the sea coast, forest, energy supplies, and, in general, his entire way of life.

Therefore, as an attempt to aid the process of developing in the public an environmental assessment capability, the Greenwich Township Environmental Analysis Project came into being. (See PREFACE for brief history of the project.)

With funds from the Pennsylvania Ecological Science Consortium (administered at West Chester State College, West Chester, Pa.) under the Higher Education Act of 1965; Title I - Community Service and Continuing Education Programs; support from Kutztown State College, Kutztown, Pa.; and the Gifford Pinchot Group of the Sierra Club, Lenhartsville, Pa., a team of researchers was assembled. A major goal of this team was to cope with the problem of large-scale environmental analysis by employing techniques available to the public.

This heterogenous team composed of professional teachers and researchers as well as laymen and students and representing a broad spectrum of personal, public, and academic interests delineated the following objectives for the project:

1. Develop a list of references, resources (including individuals) and material for each area of the study.
2. Develop a model whereby lay persons may conduct similar studies of their own (particularly at the township level).
3. Develop an Environmental Quality Index on the basis of the results.
4. Indicate areas to be protected from development on the basis of their contribution to the environmental quality of the township.
5. Use the results to persuade decision-making bodies of the necessity for such analysis-inventories as guidelines for proper land management.

6. Involvement of college and community personnel to increase the numbers of direct participants in environmental concerns. Involve college students in the project through formal course work or direct research.

7. Suggest future studies on the basis of research data. These studies may fall into any category including scientific investigations not directly related to the analysis.

8. Provide guidelines for further, more comprehensive analysis of Greenwich Township.

9. Provide guidelines for analysis of other townships.

10. Invoke a cooperative research venture between area colleges and community groups.

11. Publish and disseminate the results of the study to a maximum degree.

In keeping with these goals and with the philosophy that all facets of a large environmental area, including social as well as natural elements, are dependent on each other, the GTEA team defined ten study areas: Acquatic Analysis, Wildlife Analysis, Botanical Analysis, Geological Analysis, Insect Survey, Bird Census, Historical-Economic Analysis, Political Analysis, Demographic Analysis, Analysis of Solid Waste Disposal. (At the time of this writing eight analyses were completed and included in this report. These eight represent seven of the original ten research areas, with two reports relating to the Aquatic Analysis.)

Obviously, in order to obtain an accurate description of the status of the environment in any geographic area, more data in additional areas of investigation would be necessary; such as, analysis of atmospheric gases and the effects of noise. However, the GTEA team settled on the above ten topics in that each could be completed with a minimum of training on the part of lay researchers as well as professionals and with a minimum of sophisticated equipment.

Finally, in close conjunction with the definition of goals and delineation of research topics, Greenwich Township, Berks County, Pennsylvania was selected as the site for study. The selection of this site was based on the composition of Greenwich Township (Encompassing towns, farms, forest, streams, and a major interstate highway) and on the fact that the township is just beginning to experience societal pressures for urbanization and industrialization. Thus, the township afforded a research area having many natural habitats suitable for wildlife and has been relatively undisturbed by massive human building - yet it is beginning to cope with pressures and problems of an expanding Eastern Seaboard population.

The township will undoubtedly be facing demands for land to be used for private residences and industrial sites, water to supply its own as well as nearby communities with potable supplies as well as water for recreation. Questions have arisen and will continue to arise regarding the fate of cleared, highly productive farmland as well as forest areas; questions such as: How many farms can be safely planted with crops of private homes before we face serious food shortages? How much undisturbed forest land can be timbered or cleared for industry before we cause the extinction of valuable plant and animal habitats and the life that populates these habitats? How good is the water? Can the streams produce enough aquatic life to insure both the survival of plant and animal species as well as satisfy man's demand for recreation?

These questions must be answered the world over, not just in Greenwich Township, in order to insure our own survival as well as that of wild plant and animal life. The studies presented in the pages to follow do not purport to answer all of these questions. However, they are presented as the beginnings of many answers. The data presented should serve as the beginnings of an environmental baseline upon which intelligent judgements can be founded. The procedures accompanying these studies are intended to contribute to the rapidly growing public capability to undertake their own local environmental assessments, thus building upon and strengthening the rudimentary baseline established by this project.

J. Wesley Bahorik

HISTORICAL SURVEY OF GREENWICH TOWNSHIP

BY

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Department of History
Kutztown State College
Kutztown, Pennsylvania 19530

June 15, 1974

ABSTRACT

Historical Survey of Greenwich Township

Throughout the placid towns and rolling hills of Greenwich Township, there is an air of suspended animation. The natural and human environments combine to convey the mixed sensation of something that is about to happen *and* something that did not quite happen. Greenwich Township typifies, to an extraordinary degree, the "open country neighborhood" settlement pattern that emerged in the Middle Colonies in the eighteenth century. Characteristic of this pattern is the wide dispersal of individual farms, the haphazard location of crossroads hamlets (Grimville, Krumsville, Klinesville, and Dreibelbis Station) in the open countryside or where roads met, and the absence of a town or any fixed place as a center of government and services. "Even today in the Middle Country, from New Jersey to the Rockies," Conrad Arensburg has maintained, "this is the older community form in the countryside...." ("American Communities," in *American Anthropologist*, Vol. 57 (1955), pp. 1154-1155).

The historical significance of Greenwich Township lies in the fact that the economic development of the township, as well as the cultural adaptation of its predominately German population, was arrested in the second half of the nineteenth century. The township simply did not experience the full impace of the industrial revolution (with the exception of the mechanization and specialization of agriculture) -- "the most powerful force" for observable changes in communities in the past two centuries. (Ruth E. Sutter, *The Next Place You Come To* (New Jersey, 1973), p. 5.) This is not to say that nothing has happened in Greenwich Township since approximately 1870, when the population reached its peak -- economic, environmental, and social change can be documented -- but

rather that the changes have been qualitatively and quantitatively different from those experienced by American communities which have undergone the more destructive and disintegrative effects of industrialization and urbanization.

The surviving physical evidence of early economic development is rather limited, considering that in 1844 there were six grist mills, five saw mills, four tanneries, one forge, an oil mill, and a pottery mill in the township. (I. Daniel Rupp, History of the Counties of Berks and Lebanon (1844).) But at least three sites warrant special consideration for historical preservation and restoration -- the cluster of buildings and a covered bridge (1869) at Dreibelbis Station and nearby Dunkel's Church (founded in 1744 at New Jerusalem) and Stein's Distillery, located near the Three Mile House (Liscum). Dreibelbis Station, the site of saw mills since the time of the American Revolution, took one step into the industrial age when it became a flag station for the Schuylkill and Lehigh Railraod (date not yet known).

Stein's Distillery is a good example of early Pennsylvania German architecture and physical evidence of the importance of distilling as one type of agricultural processing in the nineteenth century. Other important forms of processing in Greenwich Township were saw milling, flour milling, carding of wool and flax, tanning, and ironmaking (the Maiden Creek Furance at Lenhartsville and forge south of it). Before the railroad was constructed, Grimville was a thriving livestock town and resting place for cattle "drovers." In 1844 it had three stores and seven taverns to serve the needs of the cattle men.

The indispensable means of implementing a community study of a township such as Greenwich are local history resources, ranging from family papers and gravestone inscriptions to public records (tax rolls, property deeds, census lists, etc.) and institutional publications (churches in particular). Special emphasis should be placed on collecting more impressionistic evidence of historical development through the medium of oral interviewing. This is particularly true of Greenwich Township, where the documentary evidence is either lacking or incomplete.

Historical Survey of Greenwich Township

Pervading the placid towns and rolling hills of Greenwich Township in Berks County, Pennsylvania, is an air of suspended animation. The richly patterned grain fields and dairy farms, the carefully tended churches and cemetaries, and the beautifully preserved old houses -- all of these together convey the impression of a distinctive way of life caught at a particular moment in time. The atmosphere of Greenwich Township is still redolent of the last third of the nineteenth century, when the United States was undergoing the shift from a rural-agricultural to an urban-industrial orientation. (See Figure 3.)

Historically, Greenwich typifies to an extraordinary degree the "open country neighborhood" settlement pattern that emerged in the fertile limesone belts of southeastern Pennsylvania in the eighteenth century. Characteristics of this pattern is the wide dispersal of individual farms, the haphazard location of crossroads hamlets in the open countryside or where roads met, and the absence of a town, or any fixed place, as a center of government and services (for example, a centrally located county seat). "Even today in the Middle Country, from New Jersey to the Rockies," the anthropologist Conrad Arensberg has pointed out, "this is the older community form in the countryside, and it persists among the farms despite the growth of towns, burgs, counties, and service centers, marks of later urban consolidation."[1]

Another student of early American communities, James T. Lemon, has qualified this view with the observation that in southeastern Pennsylvania before

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[1] Conrad Arensberg, "American Communities," American Anthropologist 57 (1955):1154-55.

1820, "numerous unplanned hamlets, including those primarily identified with transportation and processing, were also central places." They served the function of "collecting points" in the broader network of commerce and trade, and in that sense provided a community focus. In these villages "taverners, millers, mine, forge, or furance operators doubled as shopkeepers, the latter serving a large number of their laborers from company stores."[2] Lemon refers to Reading Howell's "Map of Pennsylvania" for 1792, which shows the location of taverns and mills "every two or three miles along main roads and on permanent streams."[3] In Greenwich Township the borough of Lenhartsville and the four villages -- Klinesville, Krumsville, Grimville, and Dreibelbis -- are situated at intervals of no more than two or three miles apart. Lenhartsville and the first three towns (from west to east) are spaced out along the old "State Road" to Allentown (Route 22), which extends across the northern section of Berks County.

Lenhartsville and Dreibelbis are located on the Maiden Creek, the main stream of Greenwich Township, with Dreibelbis two miles south of the borough. Maiden Creek, or the Ontelaunee (an Indian word which means "little maiden"), flows in a generally southerly direction through the northwestern part of Greenwich Township.[4] From the village of Dreibelbis southward for several miles, it forms the boundary line between Greenwich on the east and Windsor and Perry Townships on the west. The southern boundary of Greenwich Township is formed by the Sacony (Saucony) Creek, which flows from the east into Maiden Creek at Virginville. Saucon or Sakunk, according to early histories of Berks County, is an Indian name meaning "a place of outlet," the place where a smaller stream flows into a larger one.[5]

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[2] James T. Lemon, "Urbanization and the development of Eighteenth Century Southeastern Pennsylvania and Adjacent Delaware," The William and Mary Quarterly, 3d series, Vol. 24, No. 4 (October, 1967), 525.

[3] Ibid.

[4] Historical and Biographical Annals of Berks County, Pennsylvania, comp. Morton L. Montgomery, 2 Vols. (Chicago: J.H. Beers & Co., 1909), 1:304.

In the pre-industrial economy of the eighteenth and nineteenth centuries, the Ontelaunee and the Sacony supplied water for the operation of distilleries and tanneries. They also provided the water power for extensive milling on the banks along their reaches. One historian of Berks comments on this activity:

> "The Saucony and its tributaries, having at places rather rapid descent, afforded water for numerous mills, grist mills, saw mills, carding mills and oil mills, as well as for gun-barrel, sickle, and grain-cradle factories."[6]

Mill Creek, one of the tributaries of the Sacony, received its name from the concentration of mills along its banks, for example, Levan's Mill at Eagle Point in Maxatawny Township and Dietrich's Mill almost directly west of Eagle Point in Greenwich. Levan's Mill was a flour mill erected by Jacob Levan probably between 1739 and 1740. This mill and a sawmill erected earlier were the first mills of this type in the Maxatawny Valley.[7] Dietrich's Mill was apparently a saw mill originally; it was operated by Johann Heinrich Dietrich (1777-1857), a son of Adam Dietrich, one of the original German immigrants to Greenwich Township.[8]

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[5] Reading and Berks County, Pennsylvania: A History, ed. Cyrus T. Fox, 3 Vols. (New York: Lewis Historical Publishing Company, Inc., 1925), 1:283-84.

[6] Ibid., p. 283.

[7] Ibid., p. 331. See also H. Winslow Fegley, "Among some of the Older Mills in Eastern Pennsylvania," Proceedings of the Pennsylvania German Society 39 (1930):53-54.

[8] Montgomery, 1:558.

According to a recent general history of Pennsylvania, "water-powered" mills were "the most widespread mechanical contrivance before the Industrial Revolution; and of the various types of mills, gristmills were the most numerous, for farmers needed a mill close to home."[9] In 1925 a history of Berks County reported that most of the mills had fallen into ruin, but that a few had been repaired or rebuilt, and some had been furnished with rollers and other modern machinery.[10] In a recent interview with Mrs. Harold A. Herring, I learned that the cider mill at Dreibelbis burned down in 1915 and was rebuilt by Will Herring, who installed the big boiler.[11] (See Figure 3-f.) Apparently, in the late nineteenth and early twentieth centuries, it was not uncommon to convert old mills, or the part of the structure still standing, into buildings housing enterprises more profitable in the industrial age.

The economic importance of milling in the pre-industrial era is underscored by the prominence of Lenhartsville (incorporated in 1887) in the historical development of Greenwich Township. The operation of several large gristmills in the area, plus the location of the town on the "State Road," made it an important commercial center quite early. The town was named for the Lenhart family, who were the original landowners in the area. Johannes Lenhart, probably the son of Jacob (the original emigrant from the German Palatinate) owned "the old mill and hotel" in the late eighteenth century.[12] When the railroad came to

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[9] Philip S. Klein and Ari Googenboom, A History of Pennsylvania (New York: McGraw-Hill Book Co., 1973), p. 189.

[10] Fox, 1:204.

[11] Interview with Mrs. Harold A. (Elizabeth) Herring at Dreibelbis, June 5, 1974. Mr. and Mrs. Herring are the present owners of the Dreibelbis buildings.

[12] Montgomery, 1:263. For conflicting genealogical data, see Montgomery, 2:819 and 1680.

Greenwich Township a century later, Lenhartsville became a station on the Schuylkill Railroad, known first as the "Berks County Railroad."

The Berks County Railroad Company was incorporated in 1871 by the state legislature to construct a railroad from a point near Birdsboro through Reading to connect with the railraod in Lehigh County. This railroad was completed in 1874 but mortgaged and sold to the Schuylkill and Lehigh Railroad Company. It was later operated by the Philadelphia and Reading Company. The road, which is forty-two miles long, extends from Reading to Slatington and parallels the Maiden Creek for a distance of eighteen miles.[13]

The hamlet of Dreibelbis, two miles south of Lenhartsville, served as a flag station of the S. & L. R.R. as late as 1925. But the economic importance of Dreibelbis in the pre-industrial era must be attributed to milling. Mills of various types have been operated at Dreibelbis since the American Revolutionary period:[14] a sawmill, a cider mill and apple butter cookery, and perhaps even a clover mill.[15] (See Figure 4, c, d, e.) According to a study of early mills in eastern Pennsylvania, Christopher Sontag owned a mill called the Cross Keyes on the Ontelaunee in 1790. Near the mill was a hotel from which the name was taken. In front of the hotel stood a post twenty feet high displaying a hand-painted, oval shaped sign with a picture of two keys crossed in the center.[16]

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[13] Fox, 1:284. Montgomery, 1:304. See also F.W. Balthasar, The Story of Berks County, Pennsylvania (Reading, Pa., 1925), pp. 115-116.

[14] Fox, 1:285.

[15] Mrs. Herring is attempting to trace the origins and the uses of the mill through the deeds to the property. She has established the purchase of a mill in the Dreibelbis location by Christopher Sontag (born April 9, 1753, died December 13, 1825), on September 9, 1791, recorded in Patent Book No. 18, p. 181.

[16] Fegley, p. 47.

Christopher Sontag's father was Hendrik Sondagh, who arrived in Philadelphia from Rotterdam on October 2, 1741, in the ship "St. Andrew."[17] The Sunday (translation of the German "Sontag") ancestors were active members of the New Jerusalem (Dunkel's) Church near Dreibelbis and are buried in the beautiful cemetary of the church. (See Figure 6-a, b.) Dreibelbis was not named for the Sunday family, however, but for Manasses Dreibelbis (1813-1876), a later settler in the area. Manasses purchased the mill from his father, John Dreibelbis (1787-1847) on April 1, 1846.[18] Both families are buried at Dunkel's Church.

Two miles east of Lenhartsville, on the State Road, is the town of Klinesville, named for Peter Kline, who put up a log building and kept a store before 1800. About three miles east of Klinesville is Krumsville, originally called Smithville after the Smith family, who owned the land in the area. The name of the town was changed to Krumsville in 1885, when Mrs. William P. Krum acquired the Smith properties. The United States government established a post office in the town, giving it the new name, and Mrs. Krum became the first postmistress.[19] Today Krumsville is probably the prime development area in Greenwich Township because of its location at the junction of Routes 22 and 737 and the entrance to Interstate 78. (See Figure 5-a.)

A short distance east of Krumsville is Grimville, located near the eastern border of the township. The town was named in (See Figure 5-b, c, d, e, f) honor of "Col." Daniel Bertolet Grim, who moved from Maxatawny Township in 1824 and bought a farm of 220 acres (from a Mr. Kern), which contained a hotel, store, tannery, and distillery. Known locally as "Der Hellwedder Grim," Col. Grim ran the hotel at the sign of the "Golden Lamb" and operated the tannery until his death in 1883. He learned the tanning trade from his father Jonathan Grim, one of the early settlers of Maxatawny Township.[20] The mother of Col. Grim was Catherine Bertolet, a great-granddaughter of Jean Bertolet, the French Huguenot who immigrated from Switzerland to the Oley Valley in 1726.[21] The earliest ancestor of Col. Grim on his father's side was Egidius Grim, who emigrated from Wurttemberg, Germany to Pennsylvania in 1728, in the ship "Albany."[22]

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[17] Pennsylvania German Pioneers, eds. Ralph B Strassburger and William J. Hinke, 3 Vols. (Norristown, Pa.: Pennsylvania German Society, 1934), 1 (1727-1775); 303. This is a publication of the original lists of arrivals in the port of Philadelphia from 1727 to 1808.

[18] Montgomery, 1:501

[19] Fox, 1:285. According to Balthasar, p. 214, Krumsville was still "a flourishing village" in 1925.

In addition to his commercial operations, Col. Grim engaged in one of the most lucrative businesses of the nineteenth centry -- buying stock cattle in western Pennsylvania and the Ohio Valley and selling them to eastern farmers, "where they commanded a ready sale."[23] According to S.W. Fletcher, the foremost historian on Pennsylvania agriculture,

> "The marked increase in forage crop production and pasturage beginning about 1790, together with high prices for beef resulting from the Napoleonic wars in Europe, greatly stimulated beef pro-

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[20] Book of Biographies: Berks County, Pennsylvania (Buffalo, New York: Biographical Publishing Co., 1898), pp. 685-89. See also Montgomery, 1:316-317. "Hellwedder" would probably be translated "clear weather" in high German.

[21] Montgomery, 2:1304.

[22] Pennsylvania German Pioneers, p. 21.

[23] Book of Biographies, pp. 685-89.

> duction. The area within seventy-five miles of Philadelphia became the outstanding beef producing center of the nation."[24]

The cattle auction at Grimville, easily accessible from the William Penn Highway (one of the two main cattle driving routes in Pennsylvania), was a distributing center for the cattle trade in eastern Pennsylvania.

One indication that the cattle business was profitable in the nineteenth century is the biographical comment that Mr. Grim's business "was carried on for 45 years with excellent results."[25] As Fletcher points out, "by 1819 the beef cattle industry was so profitable that good grazing farms in the vicinity of Philadelphia sold for $100 to $300 an acre." Grimville was a thriving livestock town, and the Golden Lamb and other hotels provided a resting place for drovers in late spring and summer when the drives were made. Dirt roads were impassable at other seasons of the year.

In Fletcher's words, "the period from 1810 to 1840 was the golden age of the drover;"[26] and towns along the cattle routes catered to their needs. After a drive of some 30 to 50 days between Pittsburgh and eastern Pennsylvania, with the livestock (including hogs taken along to eat the grain wasted by the cattle) straying off the road or becoming tangled in other traffic, the drovers must have been extremely hungry and thirsty.[27] In 1844 Grimville had three stores and seven taverns to serve the farmers and cattle drovers.[28]

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[24] Stevenson W. Fletcher, Pennsylvania Agriculture and Country Life, 1640-1840, 2d. ed. (Harrisburg: Pennsylvania Historical and Museum Commission, 1971), p. 179.

[25] Book of Biographies, pp. 685-89.

[26] Fletcher, pp. 179-80.

[27] Ibid., p. 181.

[28] Daniel Rupp, History of the Counties of Berks and Lebanon (Lancaster: G. Hills, 1844), p. 187.

It was mainly the construction of the railroad that brought this colorful and prosperous period to a close. About the same time an offshoot of another major Pennsylvania industry was established in Greenwich Township -- the ironmaking industry, which had expanded steadily in Pennsylvania since the decade of the 1720's. In 1854 the Maiden Creek (charcoal) furnace was erected by George Merkel a short distance east of Lenhartsville, with a forge nearby. A post office was established at the furnace store east of the creek in the same year.[29]

The Maiden Creek Furnace was operated successfully by George Merkel for thirty years; the last proprietor was Jacob K. Spang of Reading.[30] The ore for the Maiden Creek Furnace came from the Moselem Mines. The Moselem Forge, erected by J. Shoffer on Maiden Creek in 1760, appears on an authoritative list of Pennsylvania ironworks in the eighteenth century. The Sally Ann Furnace, erected by Valentine Eckert on the Sacony Creek in 1791 also appears on the list. Since the Maiden Creek Furnace was constructed late in the ironmaking period, it is not included.[31]

It would be interesting and instructive to try to assess the environmental impact of intensive farming, milling, and ironmaking on Greenwich Township. When Peter Kalm, the Swedish naturalist, travelled through southeastern Pennsylvania in 1748, he commented on the destructive effects of mills on the natural environment. On a morning's trip to Chester, Kalm observed several sawmills and "likewise perceived that the woods and forests of these parts had been very roughly treated."

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[29] Fox, 1:285. Fox reported in 1925 that both the furnace and the forge were in ruins. Montgomery, 1:264.

[30] _Ibid._

[31] Arthur C. Bining, _Pennsylvania Iron Manufacture in the Eighteenth Century_, 2d. ed. (Harrisburg: Pennsylvania Historical and Museum Commission, 1973), pp. 172, 174.

"It is customary," he said, "when they erect sawmills, grist mills, or ironworks, to direct the water by a different course almost horizontally until they come to a place suitable for building." He further attributed the decrease in the number of fish in part to "numerous mills on the rivers and brooks" whose dams prevent the fish from foing up the rivers to spawn.[32]

Peter Kalm also deplored the squandering of wood for fuel and for the construction of the zigzag worm-fences, which lasted at the most twelve years, depending on the type of wood used.[33] In addition to these wasteful practices, a vast amount of wood was consumed in the form of charcoal by the iron furnaces.[34] According to one estimate, "an average furnace denuded an acre of woodland every day and consumed around 6,000 cords of wood a year."[35] Wood was the basic material of all construction, manufacturing, farm implements, and household utensils.

Almost all the iron plantations had a sawmill to prepare timber for the construction of buildings and for other purposes. "On the stream faw below the furnace or forge was the grist mill, built of logs, thick boards, or stone," as one historian describes the iron plantation, and "the sound of grinding that issued forth was soft and low, for the machinery was all made of wood."[36] The stream was spanned, of course, by a covered bridge constructed completely of wood. The pre-Civil War period was truly America's "wooden age." (See Figures 3-f, 4-a, b.)

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[32] Peter Kalm's Travels in North America: The English Version of 1770, ed. Adolph B. Benson, 2 Vols., (New York: Dover Publications, Inc., 1964), 1:282.

[33] Ibid., p. 239.

[34] According to Arthur Bining, p. 20, forges used much less wood than furnaces, but still a large amount.

[35] Klein and Hoogenboom, p. 190.

[36] Bining, p. 24.

Greenwich Township, originally part of Albany Township (created in 1752), was established as a separate township in 1755. The first tax assessment of the township bears the date 1754, however, and was probably made in 1752, when the original townships of Berks County were created.[37] There was no general influx of white settlers into the Ontelaunee section of the county until after 1732, when the territory was ceded to the proprietary government of Pennsylvania by the Schuylkill Indians. The earliest settlers were English Quakers, who took up large tracts of land in the area of Ontelaunee and Maiden Creek townships. The English place name "Greenwich" originated with the English Quakers, who controlled the politics of Berks County.[38]

About the same time as the arrival of the Quakers in the Ontelaunee section, a heavy German immigration began. Most of the Germans were from the Palatinate (Pfalz), or middle Rhine region of Germany. Among them were some French Huguenots (Protestants) fleeing from the religious persecution of a Catholic monarchy. The names Bertolet, Levan, and Merkel mentioned earlier are of Huguenot origin. The Germans entered the section "by way of the Manatawny Creek and the Oley Hills, and also by way of the West Branch of the Perkiomen Creek and the Hereford Hills" and took up "great quantities of land which reached from one end of the section the the other." In fact, by 1740, they were no numerous that they had settled six townships encompassing the entire section.[39]

In his penetrating study of the historical development of the Middle Colonies, Thomas J. Wertenbaker points out that "to the German peasant the possession of land was the most important temporal concern in life;" and when he found that in Pennsylvania he could purchase 100 or perhaps 300 acres for the price of a dozen acres at home, "he stretched his means to the limit to purchase." One effect of the large size of the average holdings of farmland of the Pennsylvania Germans was to make "the establishing of the agricultural village, that foundation stone of German rural economy, impossible." In Pennsylvania farmers could not go out of villages in the morning and walk a mile or five miles to work individual holdings averaging hundreds of acres. So the basis of agricultural life became, not the village or manor", Wertenbaker maintains, "but the independent farm."[40]

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[37] Montgomery, 1:8.

[38] *Ibid.*, pp. 23, 303-304.

[39] *Ibid.*, p. 304.

Although the early German settlers were not able to establish the closely-knit agricultural village of the Palatinate in Pennsylvania, they did transfer their cultural heritage to an extraordinary degree: their language, religion, architecture, agricultural methods, mechanical crafts, peasant art, folklore, customs, etc.[41] In 1909 a historian of Berks County commented on the extent to which the Pennsylvania German culture still survived:

> Nearly two hundred years have elapsed since, but the general features of the whole community bear their impression. Their manners and customs have been handed down from generation to generation, with little change; and their language is still in general use in every section.

The language of the Pennsylvania Germans is "Pennsylvania Dutch," a melange of High German, various German dialects, and mixed and contracted English words.[42] It can still be heard in almost any public place in rural Berks County.

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[40] Thomas J. Wertenbaker, The Founding of American Civilization: The Middle Colonies, (New York: Charles Scribner's Sons, 1949), pp. 270-71.

[41] Wertenbaker, p. 269.

[42] Montgomery, 1:61-62.

The genealogical continuity of Greenwich Township is equally striking. Families who are prominent in the area today can, and do, trace their ancestors back to the original settlers. In the cemetary of Dunkel's Church, for example, there is a granite grave monument in the form of an open book, bearing this inscription: "In memory of David Heinly. Born October 17, (See Figure 7-e) 1728. Emigrated from Germany in 1774. Erected by his descendants to their first American ancestor. August 15, 1903. At the fifth annual Heinly Family reunion." The name David Heinlen appears on the ship list of the "Patience" for September 19, 1749.[43] According to Cyrus T. Fox, David Heinly received from Thomas and John Penn, on July 21, 1774, a patent for about 300 acres of land, now in Greenwich Township, a portion of which is still owned by his descendants.[44]

One gravestone in the cemetary of New Bethel's Zion's Church, near Grimville and Krumsville, gives complete genealogical information on the Herring family descended from Johann Gorg Horing (Herring). Gorg Horing, accompanying his father, Johann Gorg Horing, arrived in Philadelphia from Rotterdam on August 24, 1750 on the ship "Brothers." He, along with George Kamp, Christian Ungerer, and Andreas Unangst arrived in Philadelphia from the Palatinate and Duchy of Wurttemberg on September 19, 1749. His daughter, Marcretha, five years old at the time, later married Gorg Horing.[45] Other families who helped organize the Bethel Church were the Schlenker, Grim, Gruber, Kohler, Dietrich, Gerringer, and Bennehoff families -- names that are highly visible in Greenwich

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[43] Pennsylvania German Pioneers, 1:409.

[44] Fox, 1:436-37.

[45] Pennsylvania German Pioneers, 1:437. The ship's list bears the name Johann Gorg Horing, so apparently Gorg Horing was a child under sixteen years old.

Township today. (See Figure 8.)

One of the largest and most prominent families in Greenwich Township is the Dietrich family, one of whose founders, Adam Dietrich, was born in the German Palantinate on October 28, 1740. In 1751 Adam's elder brother Johannes immigrated to Pennsylvania and settled in Greenwich about 1760. Adam and another brother, Casper, bollowed him in 1767. The old tax lists of Berks County show that by 1779 Adam owned 130 acres of land, four horses, and three cows. In 1787 he bought 60 acres in Greenwich and in 1809 a tract of 200 acres, in addition to owning tracts in Kutztown, Maxatawny Township, and Northumberland County.[46] (See Figure 7-b, c, d.)

Adam Dietrich and his wife, Maria Barbara Steinbruch, are buried in the cemetary of the Moselem Luthern Church (established in 1742); but one of their seven sons, Johann Jacob (born June 25, 1773; died September 1, 1857) is buried at Lenhartsville in the cemetary of Frieden's United Church of Christ Church, where he was an official member. Frieden's (See Figure 7-a, b) Church was founded in 1856 as a "union" church, that is, a union of Luthern and Reformed.[47] The original congregation of Frieden's Church sprang largely from Dunkel's Church, three miles southeast of Lenhartsville. The ground for the church and the cemetary was donated by George Merkel and his wife Fanny. Luthern members of the church council in 1856 were John A. Dietrich, Reuben A. Dietrich, Samuel Baver, George Merkel, and George Yenser.[48]

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[46] See the ship lists for the years 1751 and 1767, in Pennsylvania German Pioneers, 1:471, 717; and Montgomery, 1:552-53.

[47] Montgomery, 1:554.

[48] Rev. Mark K. Trexler, The Luthern Church in Berks County, 1723-1958, (Kutztown: Kutztown Publishing Co., 1959), p. 84.

In his report to Halle in 1754, Rev. Henry Melchior Muhlenberg, the spiritual leader of the Lutherans in Pennsylvania, observed that the third period of German immigration to Pennsylvania 1720-1730, was marked by a great increase in "the number of High German Evangelical Christians, from the German Empire, the Palatinate, Wurttemberg, Darmstadt and other places."[49] It was these immigrants who founded and constructed the two oldest churches in Greenwich Township -- New Jerusalem (Dunkel's) Church, south of Lenhartsville, and New Bethel Zion's Church, near Grimville. "Dunkel Kirche" is the older church of the two. The plaque beside the entrance of the present building indicates that it was organized and built in 1744 as a Reformed "High Dutch" church. A second log cabin church was built in 1790 on land donated by Conrad Koch. The brick building that still stands today was constructed in 1859. The 1790 church was "union," a situation necessitated by the small number of reformed Germans. The Dunkel family, founders of the church, is buried in the church cemetary, which is cared for by Mr. and Mrs. Harold A. Herring of Dreibelbis.[50] (See Figures 9, 10.)

The second oldest church in Greenwich is New Bethel Zion's Church (name on the 1923 lintel stone), founded in 1761. The origins of this church date back to the Palatinate Germans who settled in the vicinity of Grimville (See p. 15). Circuit riders were the first preachers to minister to the Lutherans in this area; and Count Zinzendork, the Luthern leader of the Moravians, supposedly preached to the settlers at Levan's Mill, Eagle Point. The "Bethel" Church was Lutheran until 1844 when equal privileges and half interest in the church were given to the Reformed congregation, which had used the church for occasional services.[51]

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[49] Quoted in Introduction to Pennsylvania German Pioneers, 1:xv.

[50] Fox, 1:288. Interview with Mrs. Herring.

The history of the Bethel Church illustrates the difficulty of assessing the historical importance of Greenwich Township in terms of surviving historic landmarks and material artifacts. When the original log building of the Bethel Church became too small for the congregation, they erected a new stone building in 1803, and named the church "Bethel Zion." The 1803 building remained until 1923, when the congregation had it torn down to make room for another church building. Apparently the 1803 building was so solidly built that the church council had to hire a demolition expert to destroy it by dynamite.[52]

The surviving physical evidence of early economic development in Greenwish Township seems rather limited, considering that in 1844 there were reportedly six grist mills, five sawmills, four tanneries, one forge, an oil mill, and (located in Lenhartsville) a pottery mill, in the township.[53] But several sites warrant special consideration for purposes of historical preservation: The cluster of buildings and the covered bridge (dated 1869) at Dreibelbiss and nearby Dunkel's Church and cemetary; (See Figures 4, 6, 9, 10) the wonderful, spacious old buildings at Grimville -- reportedly the original house, hotel, and store; and Stein's Distillery, located near Three Mile House (See Figure 12-a and 11) (Liscum). Dreibelbis is not only a particularly lovely and unusual spot, but the buildings represent more than one stage of economic and social development. The gracious brick house presently owned by the Herrings was not constructed until 1895, by B.L. Wagaman; but the property was purchased on April 4, 1889 by David Wagaman, who got the cider mill going. The beautifully preserved small stone buildings are older than the covered bridge.[54] (See Figure 6-c, d, e, f.)

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[51] Rev. Trexler, p. 121. The present road sign reads "Mt. Zion Luthern Church."

[52] Fox, 1:287. The Bethel Church is referred to in old documents as the "Crolle Kirche," named for the Croll family.

[53] Rupp, p. 187.

Stein's Distillery is a good example of an early Pennsylvania German stone cabin, and attests to the importance of distilling as one method of processing agricultural products.[55] According to one history of Berks County, Stein's Distillery (or "Pierre Lodge") is one of the oldest buildings in Greenwich Township.

> "It was built by Henry Kohler, one of the first settlers, and early came into the possession of the Steins. The structure is of stone, built over a large spring of unusually excellent water. The building was used for a long time by Adam Stein as a warehouse for his distillery, the product of which had a wide reputation."[56]

The sprawling old stone house across the road (located on "Kohler's Hill") is the Fisher house, part of the original Fisher homestead in the southern part of Greenwich Township. (See Figure 12.) Henry Fisher owned 342 acres of farm land in Windsor and Greenwich Township and assisted in building Dunkel's Church (the third building in 1859) and Frieden's Church (1856).[57]

In terms of current environmental concerns, the historical significance of Greenwich Township, in my view, lies in the fact that the economic development of the township and the historical adaptations of the population to the environment were partially arrested sometime in the last third of the nineteenth century. The township simply did not experience the full impact of the industrial revolution (except in the sector of agriculture) -- "the most powerful force" for observable changes in communities in the past two centuries.[58] This is not to say that nothing has happened in Greenwich Township since 1870, the year in which the population reached its peak (2,151); economic, environmental, and social change has been documented in this paper. But it seems apparent that the changes have been qualitatively and quantitatively different from those experienced by American communities which have undergone the more destructive and disintegrative effects of industrialization and urbanization in the United States.

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[54] Interview with Mrs. Herring.

[55] G. Edwin Brumbaugh, "Colonial Architecture of the Pennsylvania Germans," Proceedings of the Pennsylvania German Society 41 (1935):30-39.

[56] Fox, 1:285.

The indispensable means of implementing a community study of a township such as Greenwich are local history resources of various kinds: county histories, family papers and newspaper clippings, gravestone inscriptions, public records (tax rolls, property deeds, census lists, etc.), institutional publications (for example, church bicentennial booklets), and museum and archaeological artifacts. Special emphasis should be placed on collecting more impressionistic evidence of historical development, through the medium of oral interviewing. This is especially true of Greenwich Township, where the documentary evidence is either lacking or incomplete.

Oral interviewing -- involving locating informants, drawing out information, and collating bits and pieces of information -- is extremely time-consuming, but often rewarding. For example, a casual conversation with the bartender at the Deitsch Eck Hotel in Lenhartsville brought out information about the hotel, the personal history of the bartender (who saw the old hotel burn, as a child 62 or 63 years ago), and the name of a person who knows the history of the town and has pictures of the old hotel, etc. I was struck by the bartender's remark that there are older people in the town who could tell me more about the hotel than he knew. Oral interviewing seems to have the effect of raising the level of awareness of community members in regard to the past and the physical evidence of the past. If people are interested in the history of their community, they may want to preserve some of the valuable evidence of it (buildings, bridges, photographs, newspaper clippings, etc.)

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[58] Ruth E. Sutter, The Next Place You Come To: A Historical Introduction to Communities in North America (New Jersey: Prentice Hall, Inc., 1973), p. 5.

With patience and some guidance, non-experts can use the methods and sources of localist historians to learn more about the ways in which the members of their community have adapted to their surroundings -- both natural and man-made. An investigation of this type could focus on local history sources, particularly genealogical studies; a study of the functions and uses of historic sites and buildings; and oral interviewing. Oral interviewing should not be regarded as simply a technique of collecting and preserving historical data, but rather as a method that could be used by local individuals or groups to raise the level of awareness of a community. The members of any community can become aware of the types of changes that occur in communities over time, the environmental and social implications (as well as consequences) of those changes, and the options for improving or maintaining the quality of life in the community. In Greenwich Township there seems to be a lively interest in the history of particular towns, buildings, churches, and families. Through historical investigation and preservation, this interest might be expanded into a more generalized environmental awareness.

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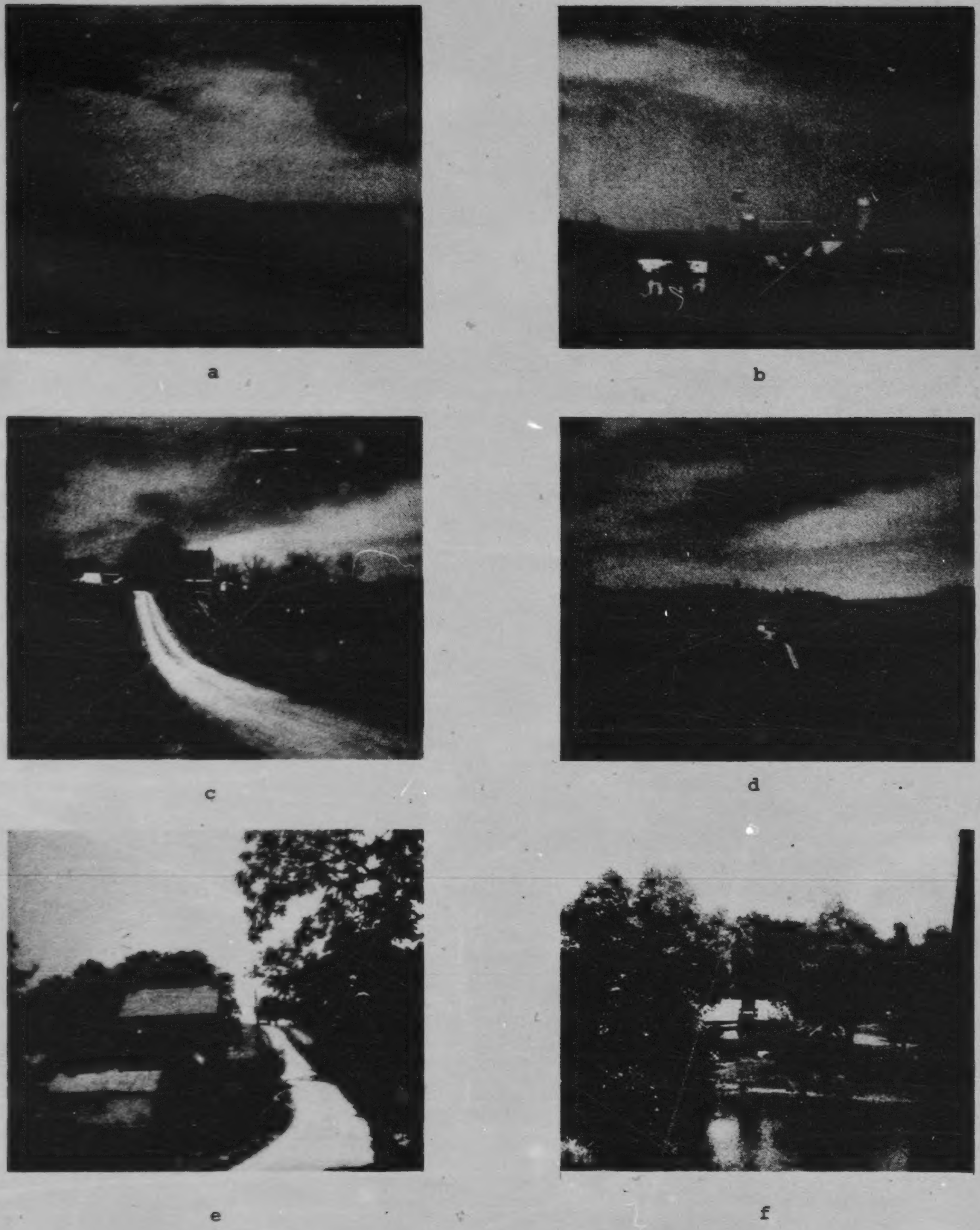

Figure 3. Greenwich Township: (a-e) Rural farmland scenes; (f) Cider mill and covered bridge at Dreibelbis.

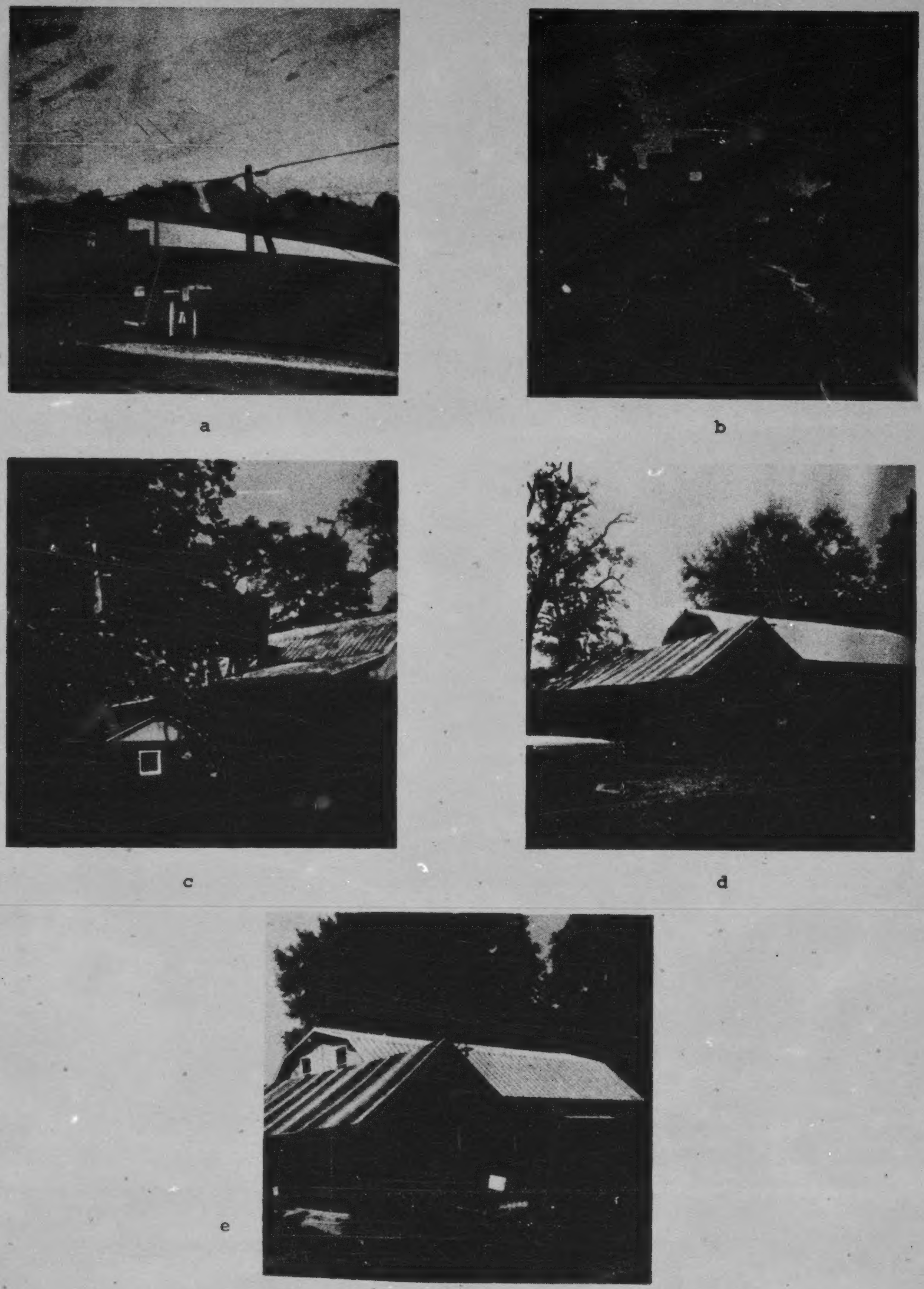
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Figure 4. Town of Dreibelbis: (a) (b) Covered bridge; (c) Cider mill; (d) (e) Sawmill.

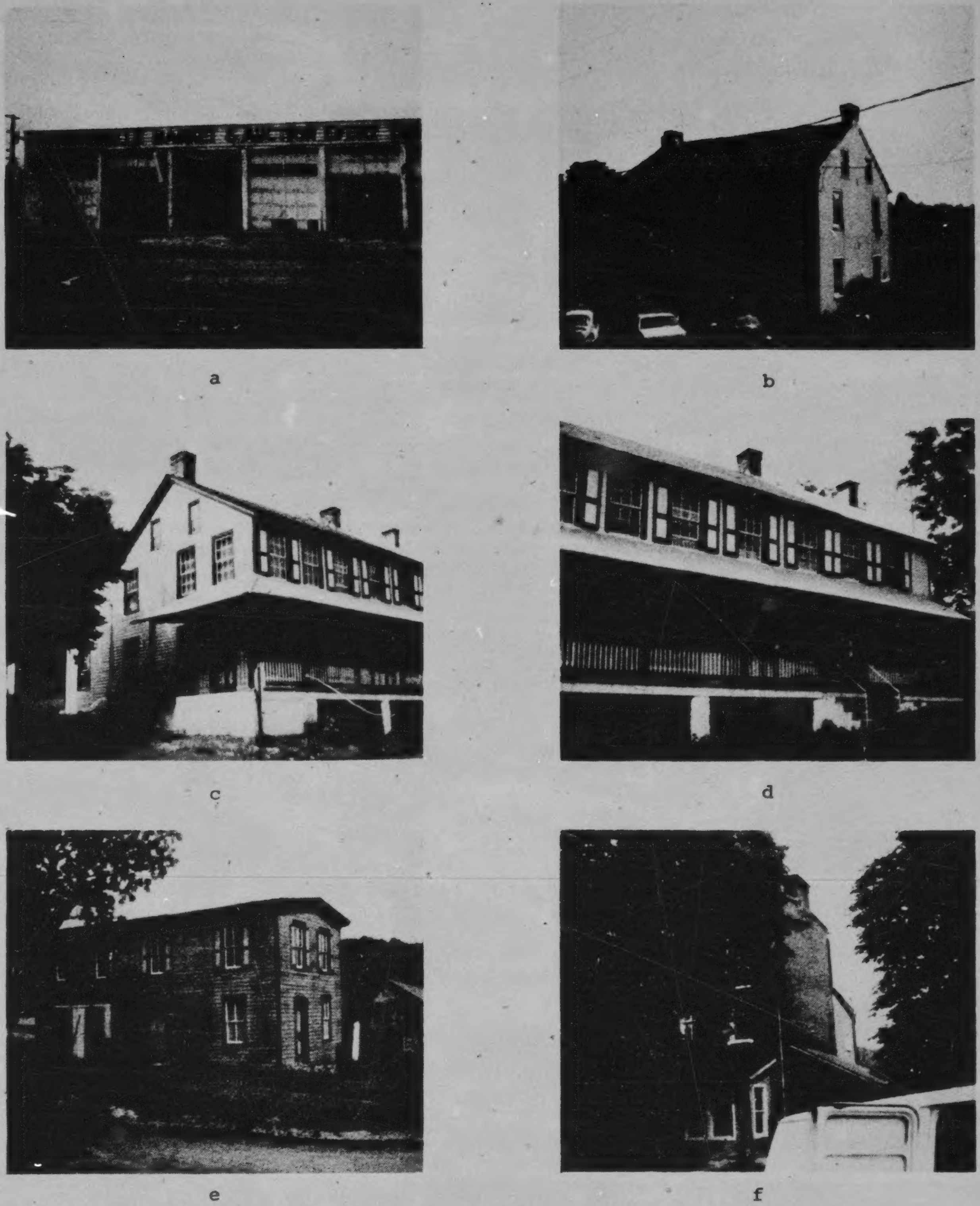
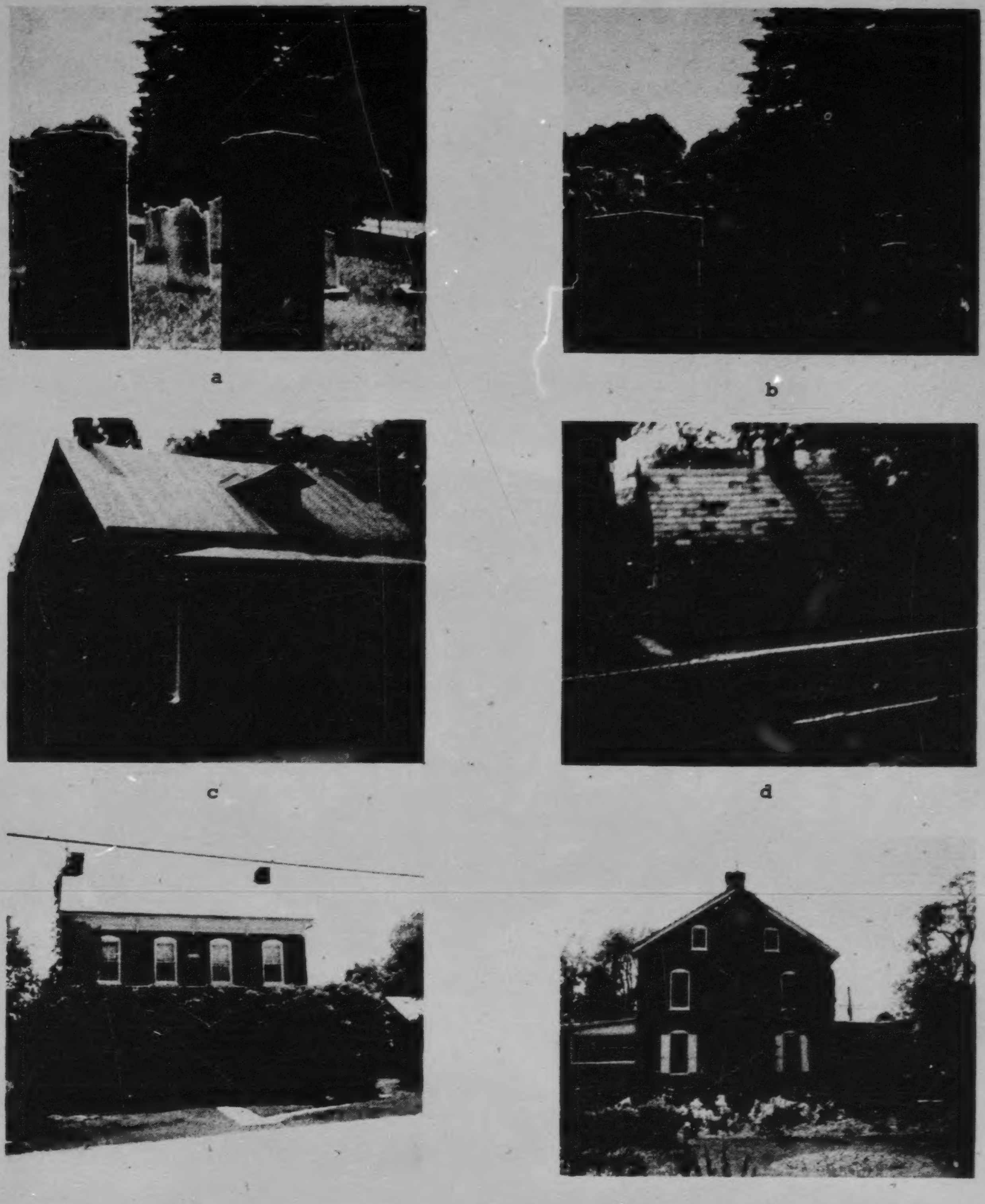


Figure 5. Krumsville and Grimville: (a) Structure at Krumsville; (b-d) Hotel at Grimville; (e) Band House at Grimville; (f) House at Grimville.



a b c d e f

Figure 6. Near Dreibelbis: (a-b) Dunkel's Church cemetary; (c-d) Stone Structures constructed prior to 1869; (e-f) House, "B.L. Wagaman, 1895."

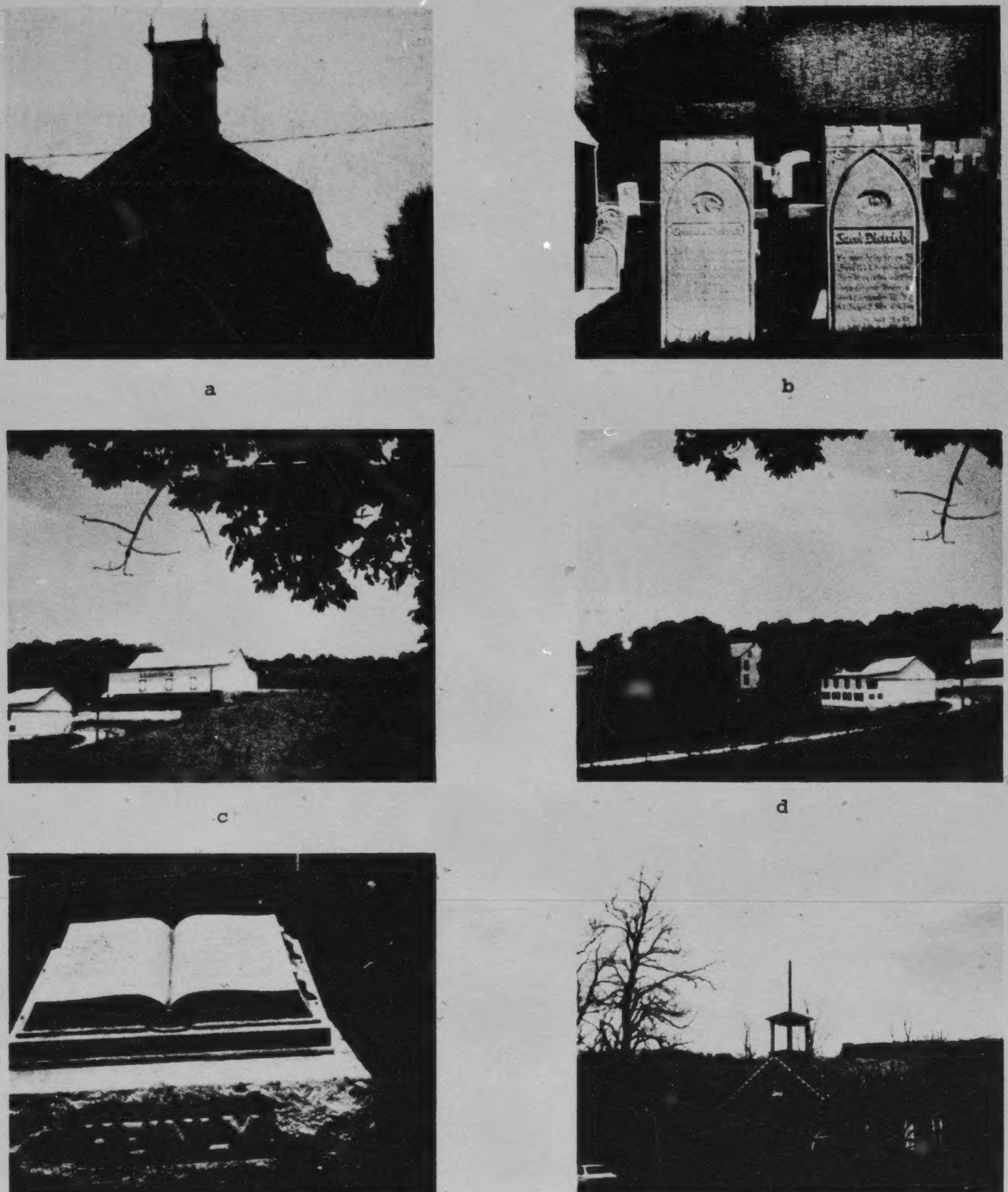


Figure 7. (a) Friedens Church; (b) Grave of Jacob Dietrich; (c-d) Dietrich Farm; (e) Early settlers grave at Dunkel's Church; (f) Early school

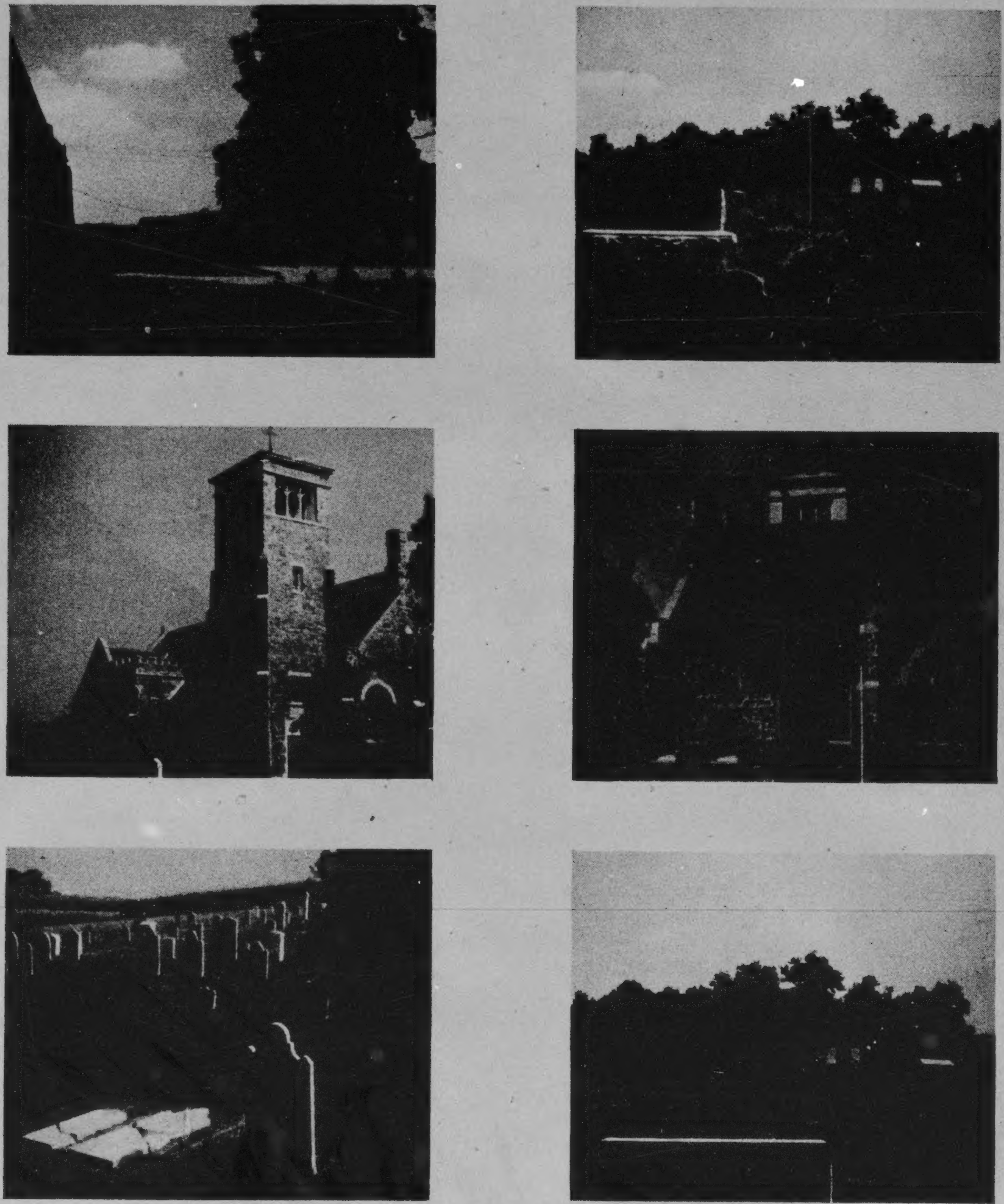
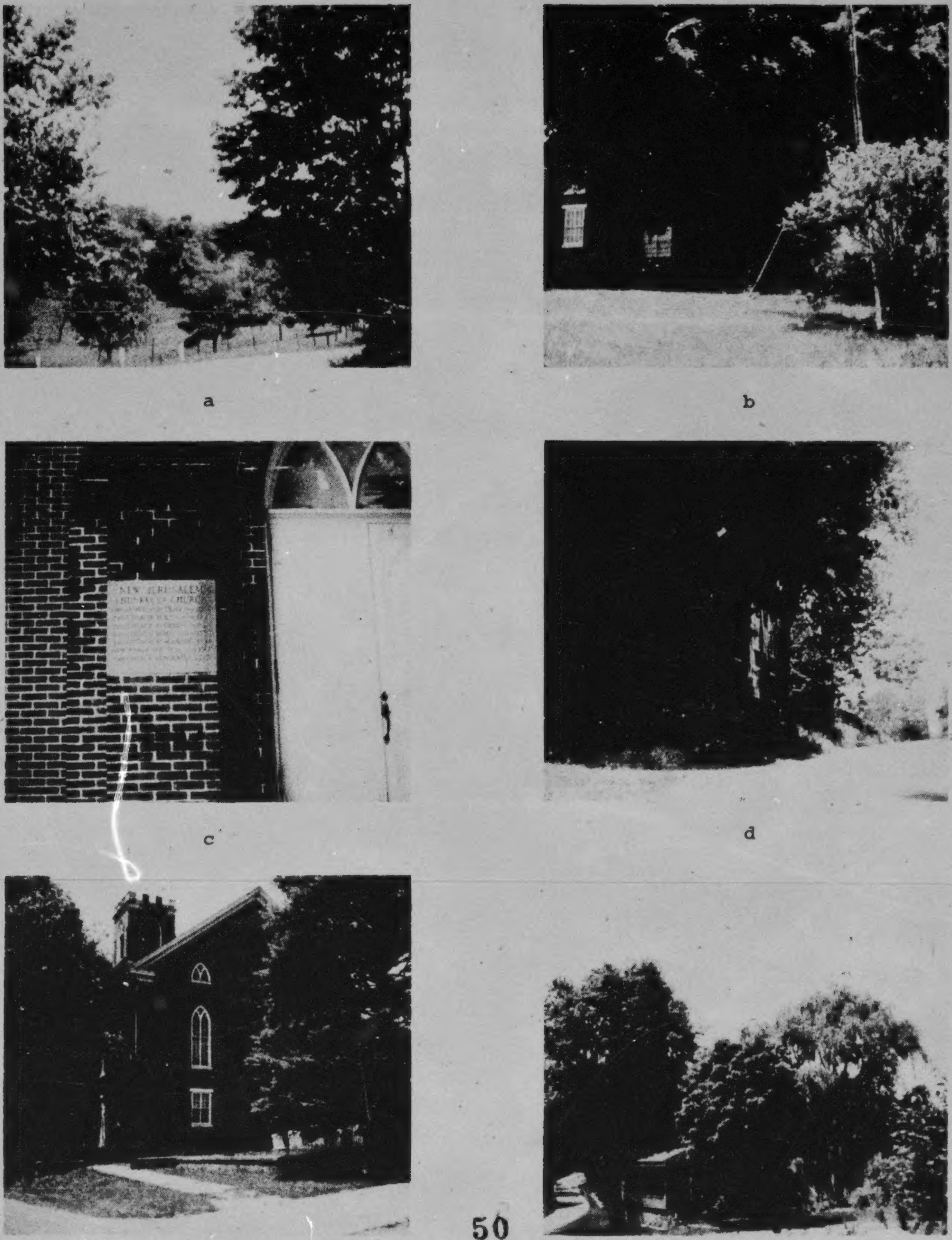


Figure 8. New Bethel Zion's Church and Cemetary.



a

b

c

d

e

f

Figure 9. "Dunkel Kirche": (a) View from mill; (b-e) Dunkel (New Jerusalem) Church; (f) Renovated schoolhouse.

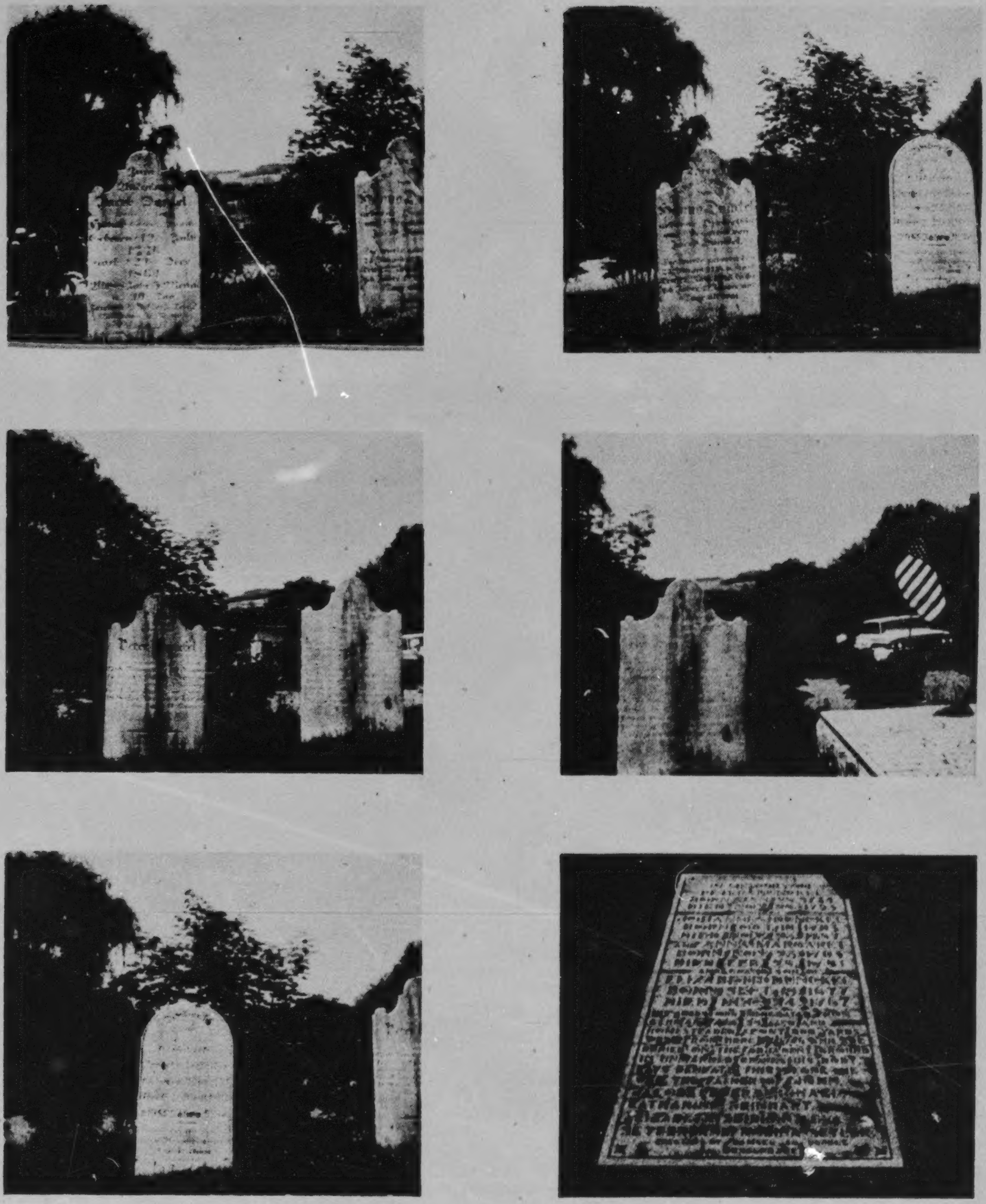


Figure 10. Dunkel Church Cemetary: Tombs of Early Dunkel Family.

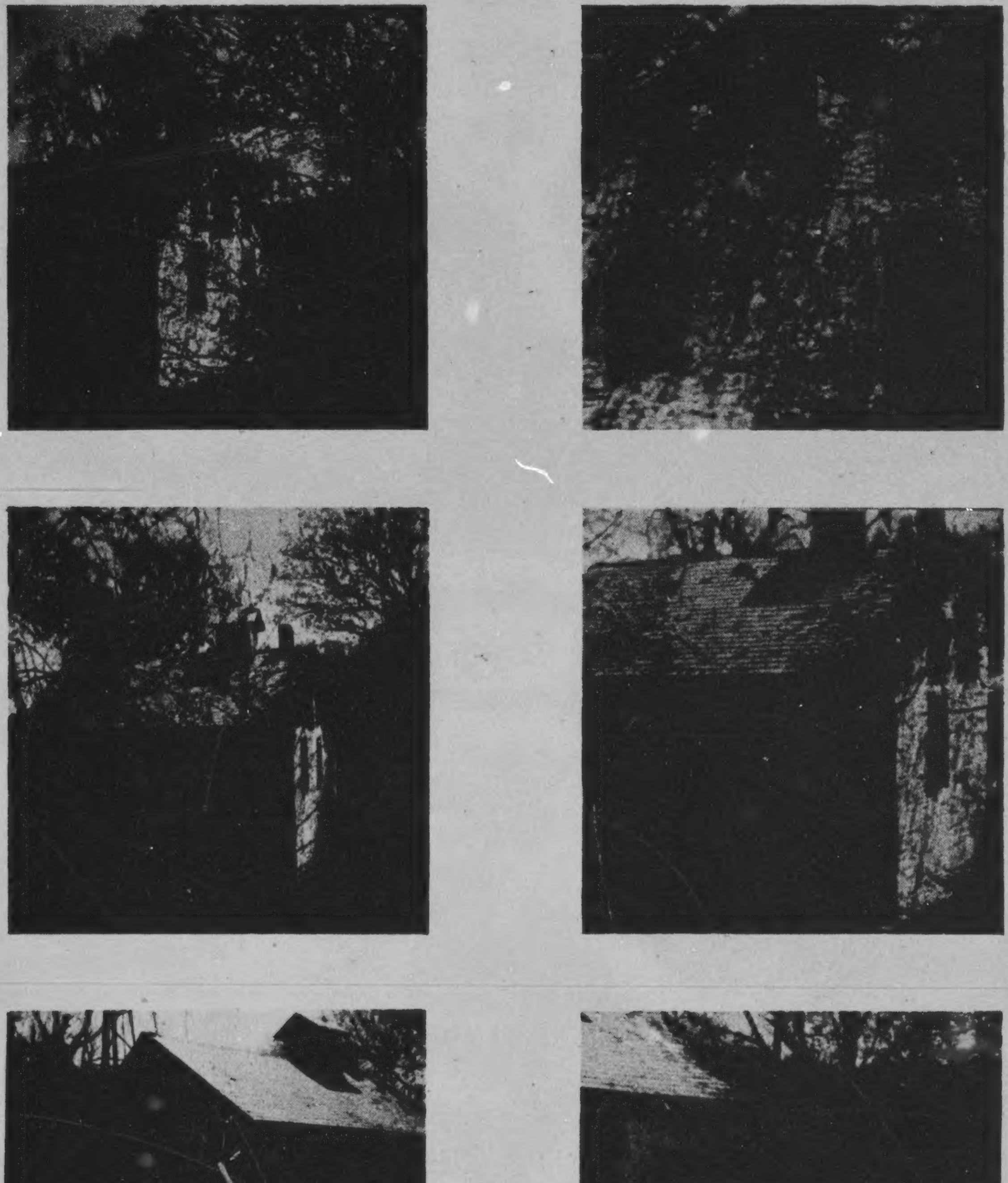


Figure 11. Stein's Distillery, example of early Pennsylvania German Stone Cabin.

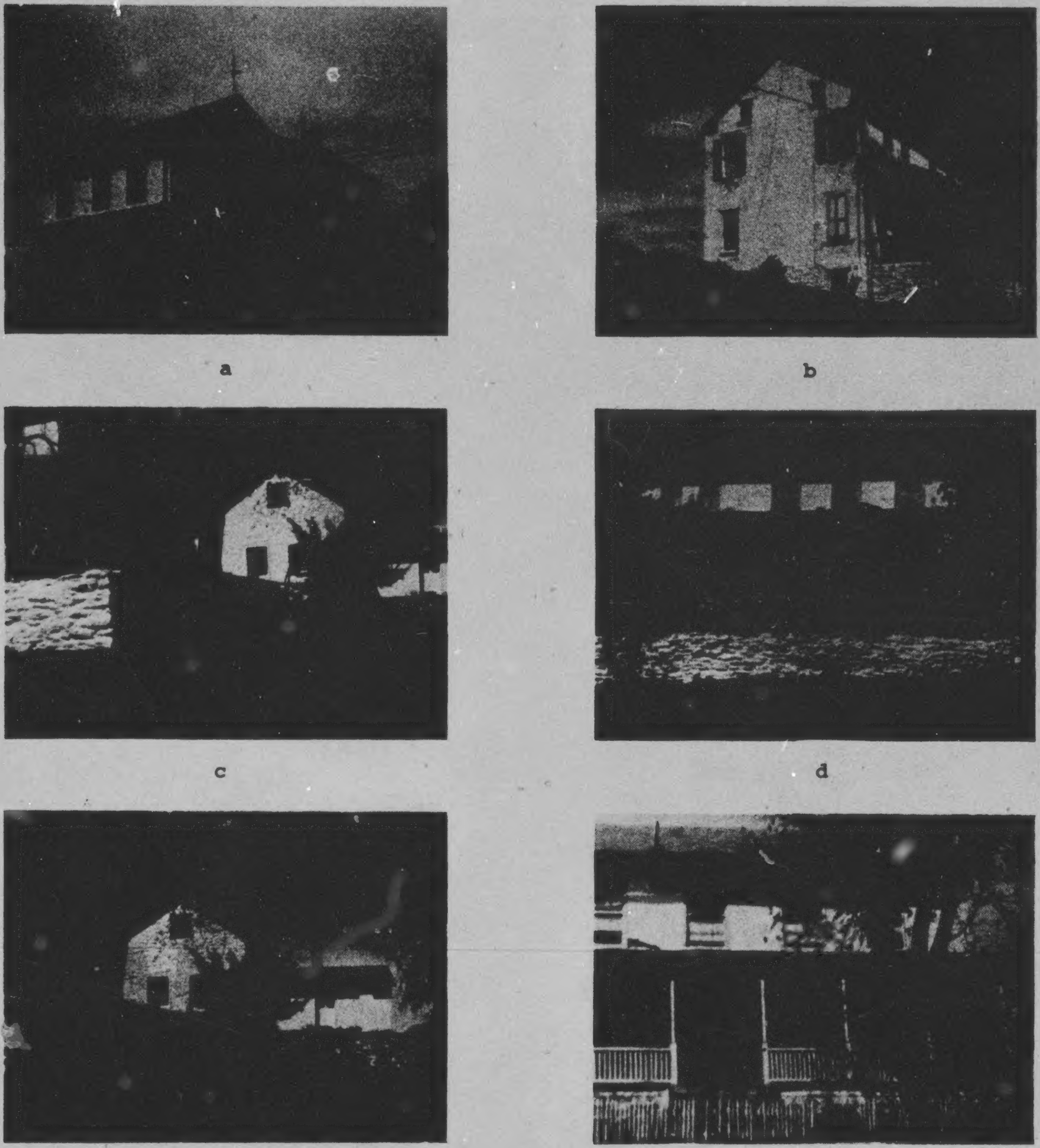


Figure 12. Early Township Structures: (a) Three Mile House; (b-f) Fisher House.

ATTITUDES TO THE ENVIRONMENT IN GREENWICH TOWNSHIP, PA.

By

Albert Dixon

Political Science Department
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Spring 1974

ABSTRACT

Attitudes to the Environment In Greenwich Township, Pa.

The funding for the political attitude aspects of this project allowed for a survey of all adults in the Township. This was carried out during the spring of 1973, and the response rate was about 25 percent. It could be argued that the results reported here are therefore biased because only those with an interest in environmental quality chose to respond. In retrospect it is apparent that a proper random sample would have been better if complete responses could have been obtained.

The survey revealed that the demographic parameter most closely associated with variation in attitude toward the environment in the township was education. This was significant on six aspects of the environment while such parameters as age, income, political party, and length of residence were significant in only one. Although concern with the quality of the environment was in all cases directly related to the amount of education, the split was not uniform, sometimes occuring at the eighth grade level, sometimes at the twelfth grade.

Although respondents felt the environmental problems were less in their township than in the nation as a whole, they felt that these problems were very important. They felt that population restrictions should be applied, and that no further development should occur without fairly rigid restrictions. Although they could not find their everyday goods in the township, they disapproved of any shopping center.

Water pollution was seen as a moderate problem, as were car dumps, but

there was little agreement on methods of solving these problems. The residents felt that zoning codes should be strictly adhered to without feeling familiar with those codes, and felt by a great margin (over 10 to 1) that surveys and questionnaires should be the basis for the planning and zoning processes.

Residents were in favor of the protection of historically important sites and liked the amount of open space as it is at the present time, but were only moderately favorable to any environmental protection programs which would increase their taxes.

ATTITUDES TO THE ENVIRONMENT IN GREENWICH TOWNSHIP, PA.

Methodology of Survey

It was felt that the most important contribution that the discipline of political science could make to the interdisciplinary environmental analysis of Greenwich Township would be a survey of the attitudes of township residents to their environment and potential changes in their surroundings. There were a number of reasons for this decision. One was sheer interest in what such a survey would reveal. A second was to make such information available to township decision-makers to use as they saw fit. A third was to make such information open to the people who live in the township, so that they may be aware of the feelings of their fellows toward zoning and development in the township.

The funding received for this project allowed for sampling by mail of all of the resident of the township as determined by a township tax list. A total of 1065 questionnaires was sent out, together with pre-addressed and stamped return envelopes, and confidentiality was assured. Only about 25% of the questionnaires were returned, and in retrospect the decision to attempt a total sample seems to have been a bad one. (A subsequent mailing concerning demography and solid waste had a return of only 10%.) Since only about one-quarter of those queried replied, and there is no assurance that these constitute a random sample, little in the way of sophisticated statistical analysis can be justified. A further problem is that the results reported below reflect the opinions only of those interested in environmental issues, and hence constitute a sample quite biased in favor of environmental controls. In comparing the characteristics of respondents in terms of age and education with township figures from the Berks

County Data Book (Berks County Planning Commission, 1973) respondents seem to be younger and better educated on the whole. Any future or similar study should probably use a carefully selected random sample and attempt to get complete returns, thus allowing the use of inductive statistical techniques.

Results of the Survey

The complete responses to survey items can be found, in percentage terms, in the appended survey instrument. What will be discussed here are apparent correlations and implications.

The survey started with a series of general questions as to age, occupation, income, education, political party, and length of time lived in township. Although not really necessary to a survey of attitudes toward the environment, the investigator was interested to see if there was any correlation between these variables and such attitudes. Specific correlations will be discussed below; suffice it here to say that the variable most often significantly associated with environmental attitudes is education. The more educated the person, the more concerned he or she is with regard to environmental quality.

Turning now to substantive attitudes, residents felt that environmental problems such as air and water pollution were much more serious nationally than they were within the township, a reasonable attitude given the rural character of the area. Still, slightly over half felt that such problems were very important locally.

Most residents (80%) felt that the population of the township was adequate, and by about three to one they felt that the future population should be limited. This last attitude was one of the few that correlated with age, with the middle aged more in favor of limitations. Education was also significant here; those with only a grade school education split evenly on whether future population should be limited, while those with high school and college educations were in favor of limitation by about eight to one.

Majorities of over 60% were opposed to the establishment of trailer courts, apartment buildings or condominiums within the township. And although two-thirds of the residents found most of the everyday goods and services which they need to be unavailable with the township, two-thirds were also opposed to the development of a local shopping plaza. This last case was one of the few items where political party affiliation was important. Those who identified themselves as Republicans or independents were evenly split, while Democrats opposed a shopping plaza by four to one. Education was again significantly related to this item; those with grade and high school educations split evenly, while the college educated opposed by five to one.

With regard to industrial development, about two out of five residents opposed any whatsoever, and practically no one favored unrestricted development. Again education correlated with opposition.

About two-thirds of the respondents felt that water pollution was only a moderate problem in the township, and feelings ran quite high on whether restrictions should be put on fertilizers and pesticides in order to curb such pollution. Those with low incomes (presumably farmers) were most hostile to any limitations, while the college educated were highly in favor. There was no agreement on what level of government should be responsible for any clean-up.

Although junked and abandoned cars were clearly felt to be a problem, practically no one felt that they should be removed at township expense. Better than four out of five felt that owners should be responsible for their removal, including all of those with a college education. (40% of those with only a grade school education did not feel the avandoned cars to be a problem.)

Township residents in general had few specific objections to the environmental conditions at present; a majority felt that open space should be kept about as it is, and there was not great feeling as to whether the township should acquire land for a park or whether streams should be opened for fishing and swimming. Only about one in five felt that specific streams needed cleaning up, chiefly Sacony and Maiden Creeks. There was support for preserving covered bridges in the township, although a majority did not know of any historic landmarks worth preservation.

With regard to the political and economic aspects of dealing with environmental planning, feelings ran quite high, though seemingly on the basis of little knowledge, since almost half the respondents stated that they were not at all familiar with current township zoning and planning procedures, and only one in eight felt quite familiar with them. A majority felt that township decision makers should be very strict in denying exceptions to zoning ordinances. The one question that elicited near unanimity of response concerned the role of ordinary citizens in the planning and zoning processes. Fully 90% felt that surveys and questionnaires should be important parts of these processes.

With regard to the type of taxes appropriate to support environmental protection and development programs, there was little agreement, and about two out of five were clearly unwilling to see any increase in taxes for such purposes. Almost no one supported using property taxes as a mode of financing.

Conclusions and Recommendations

It seems to this investigator that several conclusions, or at least speculations, can be arrived at one the basis of the data reported above and from reading the original responses with their often vivid comments. One is that the respondents are clearly concerned that the environment of the township **not** be allowed to deteriorate. They may not be willing to pay much for improving it, but they seem to strongly support the use of the political process to limit future degradation. There would seem to be a significant number of environmentally aware residents of the township, certainly enough to constitute a political force to be reckoned with if aroused.

The combination of a low degree of knowledge of zoning and planning processes with a high degree of approval for the notion of popular consultation in those processes seems contradictory. This investigator would speculate that many people fail to become informed because they feel that they can have little effect on the outcome of decisions.

If anything could be said to emerge clearly from this survey of attitudes toward the environment in Greenwich Township, it is that residents are concerned and that they wish to be consulted with regard to future decisions. From this emerges the single recommendation of this report, that machinery be established by which the citizenry can be consulted on major land use and development decisions. The township is low in population, so such participation is feasible. It is rare in the modern world for a citizen to have much to say in decisions regarding his surroundings; in this case it would seem to be not only desired but eminently possible.

KUTZTOWN STATE COLLEGE

ENVIRONMENTAL SURVEY FOR GREENWICH TOWNSHIP

The following questionnaire is part of the environmental survey of Greenwich Township being conducted by Kutztown State College. We would appreciate it very much if you would take a few minutes to answer the questions and return the questionnaire in the enclosed postpaid envelope. If possible, we would like to have all responses by April 20th. Individual responses will be kept completely confidential. Thank you for your cooperation.

Dr. Albert Dixon
Dept. of Political Science
Kutztown State College
Kutztown, Pa. 19530

1. Age

22%	Under 25
25	25-35
20	35-45
17	45-55
16	Over 55

2. Occupation

10%	Farmer
9	Business
17	Professional
33	Housewife
	Other - Please Specify ________________

3. Income

31%	Under $5,000
26	5-10,000
16	10-15,000
12	Over 15,000

4. Education

14%	Grade School
57	High School
29	College

5. Political Party

32% Republican
36 Democratic
30 No Party

6. How Long Have You Lived In Greenwich Township?

31% 0-5 Years
16 5-10 Years
18 10-20 Years
35 Over 20 Years

7. Before Moving To Greenwich Township, Where Did You Live?

22% Urban Area
20 Suburb
42 Rural

8. Just How Serious Do You Consider Environmental Problems Such As Air and Water Pollution To Be?

In The Nation As A Whole?		In Greenwich Township?	
70%	Very Important	53%	Very Important
26	Important	36	Important
2	Unimportant	9	Unimportant

9. Do You Feel That The Present Population of Greenwich Township Is:

6% Too Low
81 Adequate
10 Too High

10. Do You Feel That In The Future The Total Population Of Greenwich Township Should Be Limited?

73% Yes
23 No

11. Would You Be (a) In Favor Of, (b) Neutral Towards, (c) Opposed To The Establishment Of The Following In The Township:

70% Trailer Courts
62 Apartment Buildings
63 Condominium Developments
66 Public Housing
42 Planned Communities

12. Do You Feel There Is A Problem With Young People Moving Out Of The Township As They Grow Up?

12% Yes
59 No
26 No Opinion

13. How Far Do You Have To Commute To Work?

40% More Than 5 Miles Each Way
16 15 Miles or More

14. Do You Find Most Of The Everyday Goods and Services Which You Need Provided With The Township?

29% Yes
67 No
_____ Estimate of Miles Per Week Travelled For Shopping

15. Would You Favor The Development Of A Shopping Plaza In The Township?

33% Yes
66 No

16. Are There Any Types Of Stores, Establishments, Or Industries Which You Would Rather See Remain Outside The Township?

27% Yes - Please Specify: Large Industry 68%; All 32%; Shopping Center 10%; Mushroom 16%.
65% No

17. With Regard To Industrial Development, Would You Favor:

53% a. Restriction To Particular Locations
7 b. Opening The Entire Township To Development
39 C. Closing The Entire Township To Development

18. Do You Feel That Water Pollution In The Township Is:

24% No Problem
64 A Moderate Problem
9 A Serious Problem

19. Who Do You Feel Should Be Responsible For Cleaning Up Water Pollution?

14% Federal Government
19 State Government
25 Local Government
28 All Above

20. Do You Feel That Junked And Abandoned Cars In The Township:

12% Are No Problem
84 Should Be Removed At Owner's Expense
2 Should Be Removed At Township's Expense

21. Would You Be Willing To See Restrictions Put On The Use Of Pesticides And Fertilizers To Reduce Stream Pollution?

40% Yes
38 Maybe
20 No

22. Which Outdoor Recreation Activities Are You Interested In (Please Check All Appropriate Boxes)?

	Slight	Very	Feel Present Facilities Are Adequate
Hunting			
Fishing			
Snowmobiling			
Swimming			
Boating			
Skiing			
Golf			
Camping			
Riding			
Shooting			
Recreation for Children			

23. How Familiar Are You With Current Township Zoning And Planning Procedures?

12% Quite
42 Somewhat
46 Not At All

24. How Strict Should The Supervisors Be In Denying Exceptions To Zoning Ordinances?

55% Very Strict
16 Lenient
24 Leave It To Their Discretion

25. Should Surveys And Questionnaires Be Important Parts Of The Planning And Zoning Processes?

90% Yes
7 No

26. Do You Feel That Planned Development Would Better Fit Township Needs Than The Present Fixed Acreage Framework?

38% Yes
28 No
27 No Opinion

27. Should Zoning Procedures Focus On Present Land-Use Problems Or On Future Planning?

10% Present
18 Future
67 Both

28. Do You Feel That Specific Lakes And Portions Of Streams In The Township Should Be Open To The Public For Fishing And Swimming?

48% Yes - Please Specify: Maiden Creek
40 No

29. Are There Areas Of Lakes And Streams In The Township Which You Feel Are So Polluted As To Need Cleaning Up?

29% Yes - Please Specify: Sacony 22%; Maiden Creek 13%
53 No

30. Do You Feel The Township Should Set Aside Land For A Park Or Other Community Recreation?

53%	Yes
29	No
16	No Opinion

31. Would You Require Housing Developments Of More Than 25 Units To Include A Recreation Area?

56%	Yes
21	No
20	No Opinion

32. Are There Historical Landmarks In The Township Which You Would Like To See Preserved?

35%	Yes - Please Specify: Covered Bridges 55%
5	No
56	Don't Know

33. What Kind Of Increased Taxes Would You Accept To Pay For Environmental Protection And Development Programs?

31%	Per Capita
11	Income
5	Property
42	None Of The Above

34. What Amount Of Land In The Township Do You Feel Should Be Kept As Open Space?

61%	About Like It Is Now
29	Depends On Economic Development
5	Dont' Care

AD/mir

3/23/73

A BOTANICAL ANALYSIS

OF

GREENWICH TOWNSHIP, BERKS COUNTY, PENNSYLVANIA

by

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Beverly Linck and Diana Branch

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Cedar Crest College
Allentown, Pa. 18104

Spring, 1974

ABSTRACT

A Botanical Analysis of Greenwich Township, Berks County, Pennsylvania

A botanical study of Greenwich Township, Berks County, was conducted which involved an analysis of the upland deciduous forests. Random quadrat surveys were taken of trees 4" (d.b.h.) or larger in an attempt to determine an environmental quality index. Included in the study were determinations of average tree diamter, species diversity, index of dominance, frequency, basal area, slope and ecotone length.

Based on the 20 quadrats it was determined that the average tree is approximately 6.5" in diameter, that diversity is not particularly high (S.D. = 1.66), that birch and various species of oak dominate the forests, that most remaining forests are on North-facing slopes of often 20° or more, that the township has approximately 5 miles of ecotone per square mile, and that the forests are largely second-growth in character.

It is recommended that as much of the forest be retained as possible. If consideration is given to development, it should be in the context of the broad index guidelines established by noted authorities, such as Odum (1971) and McHarg (1969), who concede to the inevitability of development but within an ecologically sound framework.

A BOTANICAL ANALYSIS OF GREENWICH TOWNSHIP, BERKS COUNTY, PENNSYLVANIA

Introduction

This report concerns one aspect out of ten studied in an environmental analysis of Greenwich Township, Pennsylvania. This study is directly concerned with the trees of the upland wooded environment, as they are indicative of the health of the area. The findings from this survey will then be joined with surveys of the bird, mammal, fish, reptile populations, among others, in hopes that a capsule evaluation of the township may be compiled and used as a reference source for future planning, zoning and development.

Trees are indicative of the health of an ecosystem in many ways. 1) The number of trees present per unit area may simple make a parcel of land more valuable aesthetically. 2) The number may also be indicative of the carrying capacity of the soil. 3) The knowledge of kinds of trees present aids in an evaluation, as different species do best under different conditions -- whether these be climatic, biotic, or abiotic. 4) High species diversity, or the weighted number of different species present, suggests a healthy environment. "...The ecologist sees in any measure of diversity, then, means longer food chains and more cases of symbiosis (living together),...and greater possibilities for negative feedback control, which reduces oscillations and hence increases stability..." (Odum, 1971).

The nutrient cycle of woodland areas is basically a closed system. It remains closed unless some natural disaster takes place, such as fire, flood, earthquake, or unless man steps in to harvest lumber or firewood. Left undisturbed, nutrients are stored and recycled in a cyclic fashion which lends stability to the ecosystem. Secondary successional growth takes place in cut-over areas and abandoned farmland. Rate of production is generally high because many nutrients are available in the soil for rapid utilization. The flow of energy is fast in early stages and slows as the stand becomes more mature. Finally, in the climax stage, energy flow is very slow. Nutrients are locked up in the biomass for many years and are not quickly available for new growth. When a tree finally dies, it decomposes slowly and offers an addition to the available nutrient supply. These nutrients are used to maintain the biomass already present.

Virgin climax forests are growing more scarce daily. Older stands of trees are more valuable. This evaluation is not based upon age alone, however. Generally, the less developed an ecosystem is, the less stable and more vulnerable it is. "...the final or stable community in a developmental series (sere) is the climax community; it is self-perpetuating and in equilibrium with the physical habitat..." (Odum, 1971). Ideally, mature stands could be identified and analyzed. Perhaps it would be advantageous to interject what could be anticipated -- based on the literature Dr. Lucy Braun generalizes about the area in Deciduous Forests of Eastern North America:

> A great area trending in a northeast-southwest direction from southern New England and the Hudson River Valley to Northern Georgia is included in the Oak-Chestnut Forest region. Here oaks and (formerly) chestnut are as abundant in most situations as to characterize the region. Various oak, oak-chestunut, and oak-chestnut-tuliptree communities occupy the climax sites.
>
> Everywhere the occurance of oak-chestnut communities seems intimately related to slopes; only rarely do they occupy flats. Where there are extensive flat or nearly flat areas, as on the Harrisburg peneplain in the broad valleys of the Ridge and Valley Province, oak-chestnut communities do not occur; white oak forests there are the rule.
>
> Most of the ridges are covered with secondary forests; in only a few places are there remnants of primary stands. As farther south, oaks prevail in most of these condary communities. Hemlock and white pine are, however, much more frequent than in the secondary communities of ridges farther

> south, often forming dense pure stands. Sweet birch is dominant on many rocky upper slopes....
> Chestnut was a constituent of most of the oak communities, both primary and secondary, but in what proportion it is now impossible to determine, for this area is near to the original center of infection by chestnut blight, and by 1930, 100 per cent of the trees were infected and 51 to 100 per cent dead...
>
> The general impression is one of oak slopes interrupted here and there by groves of pine and by hemlock or red maple ravines.
>
> Throughout the entire north-south extent of the Ridge and Valley section, the dominance of white oak in the forest communities of the valley floor is a unifying character. Although almost all of the area is in cultivation, this feature is obvious in the numerous scattered old white oaks near towns, farmhouses, and school buildings, in the occasional white oak groves, and in the rare stands of little-disturbed forest.
>
> While white oak is the dominant species, and frequently the only one remaining, there is ample evidence to indicate that few, if any, pure stands actually occurred in the original forest cover. Frequent accompanying species include tuliptree, especially on the low swells, hickories, a number of oaks (red, black, and at the southern end of the section, Spanish oak), and white pine (in the northern part of the section). In the better stands, white oak is represented in all size classes, indicating the climax nature of the valley white oak forest type.
>
> In many place streams have entrenched their valleys below the valley floors (Harrisburg peneplain) of the Ridge and Valley section. Along these rejuvenated streams are slopes produced in a later erosion cycle. The soils are distinct from the old soils of the valley floor. Forest communities on these slopes are totally unlike those of the valleys whether level or rolling, and unlike those of the mountain slopes....Beech is an almost universal constituent of these mixed mesophytic commuities, although often present in small numbers.
>
> A brief resume of the outstanding features of the forest vegetation of the Ridge and Valley section will emphasize the prevalence of oak (originally oak-chestnut) communities on the mountain slopes, and mesophytic hemlock, hemlock-white oak, or hemlock-white pine-oak physiographic climax communities in the mountain valleys; the dominance of white oak forest on the valley floors (Harrisburg peneplain); and the local but widespread occurance of mixed pesophytic communities on the ravine slopes formed in the latest erosion cycle.

The literature search included other works besides that of Dr. Braun, but all were in support of her conclusions. The field work was started in anticipation of finding dominantly oak stands and stands of secondary succession.

All ecosystems can be placed in one of four basic types of environment: mature, productive, urban-industrial, and compromise (see also Table 6). Few areas of the township are in the latter two categories. Owing to the agricultural-rural base of the township, much of the land is cleared (farmed, fallow or pasture) and hence in the productive type of environment. The remaining wooded areas are in the mature (or in a stage evolving toward it) category. It is in the latter upland area that the thrust of this investigation is directed. The scope of the study is dictated by the size of the township, the available manpower, and the limited funding.

Methodology

Procedures for taking quantitative and qualitative measurements of terrestrial vegetation are relatively simple. Even the most difficult aspect, tree identification, can be accomplished by the layman with the aid of an identification book. When analyzing a particular habitat, the investigator will want to record parameters as ground slope, tree identification and size, location, notation of understory growth, and the direction which the slope is facing. This data is later examined by itself and in conjunction with other factors so that conclusions about the health and value of the environment can be made.

The first step in analyzing the vegetation of a terrestrial habitat is to plot the location for study. Greenwich Township covers a sizable area, and analysis of the entire community is out of the scope of the study. Instead, quadrats were set up at randomly selected sites. A quadrat is a plot of land marked off to a specified length and width, depending on the type of analysis being conducted. Measurements are then taken in these quadrat areas as representative of the community. The quadrat sites are noted in Figure 13.

Diameter breast height (d.b.h.) is the standard measurement used in determining the diameter of trees in quadrats. The measurement is taken at the breast height of the researcher, thus providing a uniform system of measurement. Vegetation greater than four inches in diameter is identified and recorded. Qualitative notation is made of smaller growth. The process of laying out a quadrat and measuring tree diameter is illustrated in Figures 14 and 15.

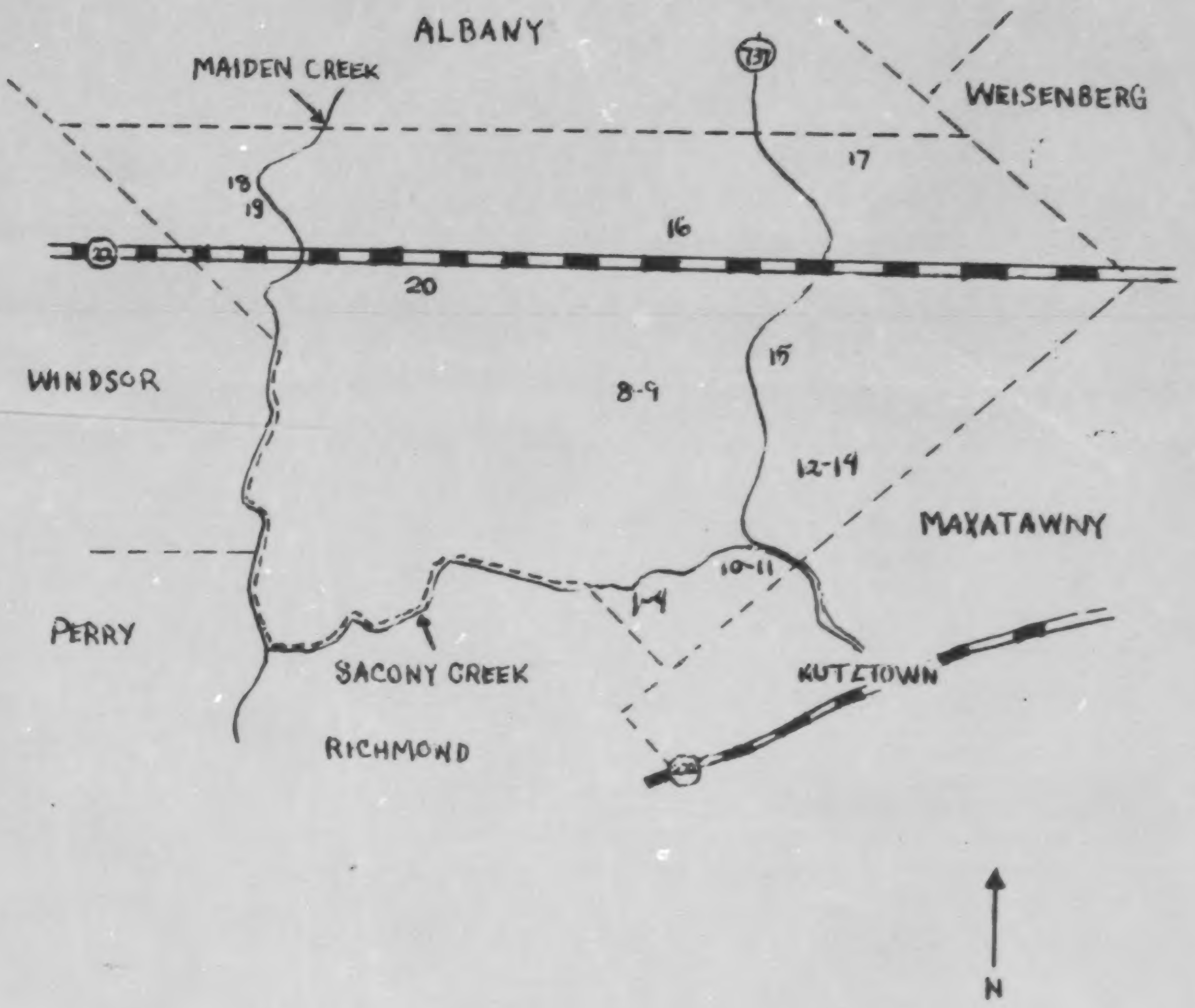
ALBANY
MAIDEN CREEK
737
WEISENBERG
18
19
17
16
22
20
WINDSOR
15
8-9
12-14
MAXATAWNY
10-11
1-4
PERRY
SACONY CREEK
KUTZTOWN
RICHMOND
222
N

Figure 13. A map of Greenwich Township and the location of the quadrats.

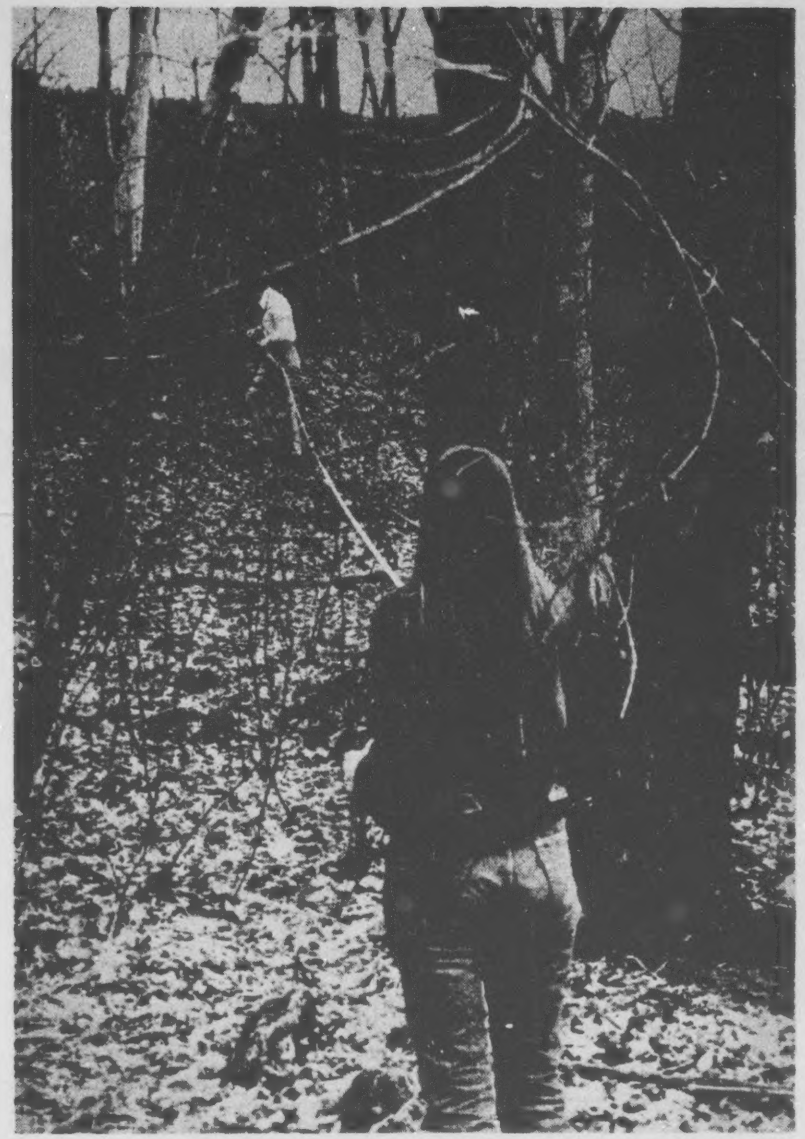

Figure 14. Measuring a quadrat. Twenty such study quadrats were laid out and tree species and size determined in each.

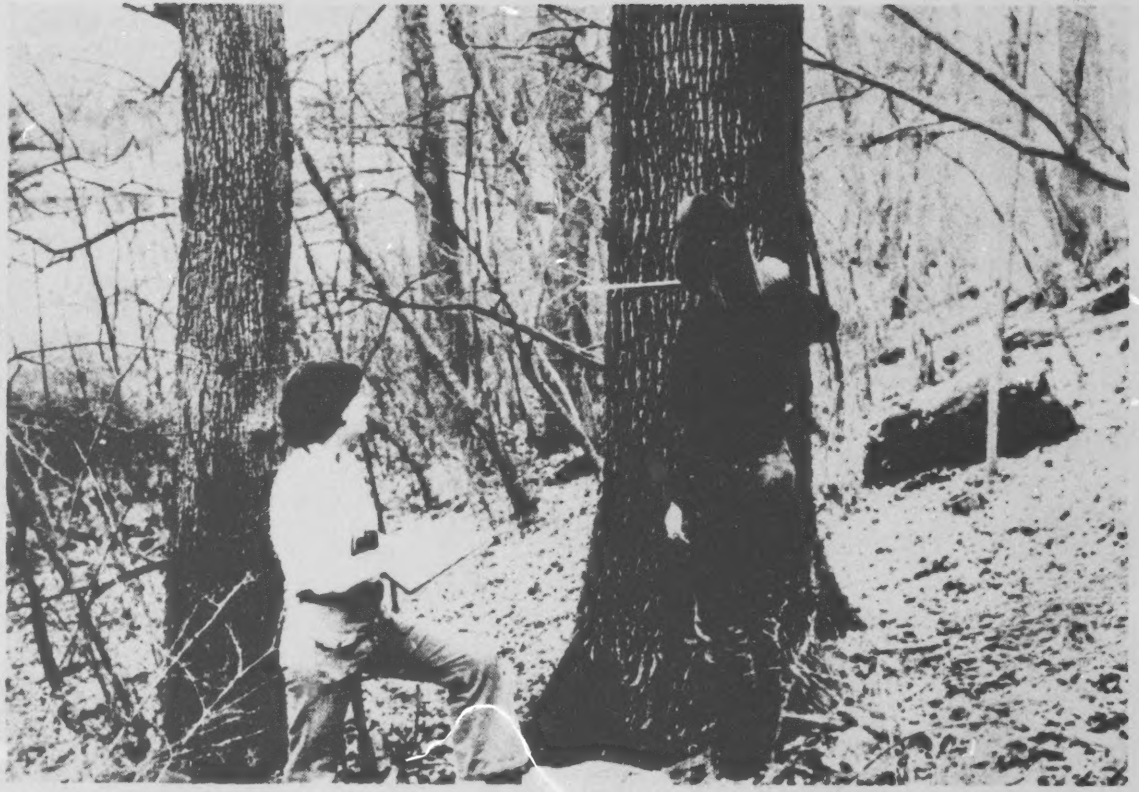

Figure 15. Measuring the diameter of a tree. Field investigators D. Branch (left) and B. Linck (right) taking a tree measurement.

A 7.5 minute topographic map of the township was used to note the forested land. Locations were then selected for placement of the quadrats. A graph depicting the cumulative species of trees is used to determine when adequate samplings have been taken. The so-called "species-area" curve (Figure 16) is plotted with the number of new additional species per quadrat on the vertical axis and the number of quadrats on the horizontal axis. Usually the curve will initially rise sharply and level off when fewer new species are found per quadrat. When the curve levels the researcher can assume few new species will be found within the community. Those that are will make little difference to the study because the habitat is characterized by the dominant vegetation.

Twenty meter by five meter (100 m^2) quadrats were used for the botanical analysis of Greenwich Township. The quadrat corners were marked with dowels and all the vegetation with a four inch d.b.h. or greater was identified and recorded. The authors also noted the understory composition and general ground cover for each quadrat. After twenty quadrats the cumulative species area curve had leveled significantly. No further investigation was then required.

Tree identification in the Winer is somewhat difficult unless one has some experience or the benefit of a good identification book and/or taxonomic key. A taxonomic key directs one to the proper identification through a process of elimination of characteristics. A key looks at the most general characteristics first, offering the observer a choice between two or three possibilities of, for example, leaf and bud arrangement on twigs. Once one of the possibilities is decided as characteristic of the tree being identified, the key will send the observer further ahead in the key to the next characteristic, thus bypassing the features irrelevant to the tree under investigation.

With the aid of binoculars, other characertistics besides the arrangement of leaves and buds on twigs can be noted. Often, the nearest branch is twenty

Table 1. Some indices of species structure in communities. After Odum (1971).

A. INDEX OF DOMINANCE (c)

$$c = \sum (ni/N)^2$$

where ni = importance value for each species (number of individual, biomass, production, and so forth)

N = total of importance values

B. INDEX OF SIMILARITY (S) BETWEEN TWO SAMPLES

$$S = \frac{2C}{A+B}$$

where A = number of species in sample A

B = number of species in sample B

C = number of species common to both samples

Note: Index of similarity = 1-S

C. INDEX OF SPECIES DIVERSITY

Shannon index of general diversity ($\bar{H}$)

$$\bar{H} = -\sum \left(\frac{ni}{N}\right) \log \left(\frac{ni}{N}\right)$$

OR

$$= -\sum P_i \log P_i$$

where ni = importance value for each species
N = total of importance values
P_i = importance probability for each species = ni/N

---

feet from the ground, making observation difficult and often the slightest difference will distinguish the difference between two species. Trees are most readily identified by the type of leaf present, but in the winter one must often rely on binoculars to compare:

1) buds: size, shape, location on twig, color.
2) leaf scars: size, shape, location on twig.
3) bark: color, texture.
4) branches: length, shape, color.

Two other parameters are the slope of the quadrats and the direction which the slope is facing. These measurements can be taken simultaneously with a Brunton compass. Another tool, an inclinometer, will give an estimate of a quadrat's slope. It works on the same principle as a carpenter's level. The degree of slope is measured by the displacement of a lead weight attached to a string.

The structure of Greenwich Township was analyzed by the indices included in Table 1, taken from Odum (1971).

Those species which are the major producers within the community are called ecological dominants. According to Odum, "the degree to which dominance is concentrated in one, several, or many species can be expressed by...(the)...index of dominance that sums each species' importance in relation to the community as a whole." Frequence of a species' appearance among the quadrats, basal area or the amount of actual timber present, and species diversity are factors which join the index of dominance in determining this important value. The abundance of a particular species in a quadrat is not always indicative of that species' effect on the community's energy flow. One mature tree may exhibit a greater effect on the environment than many saplings would. Thus, basal area is a useful indicator of species importance within the community.

The data derived from the indices of Table 1 can be compared with other findings to determine the status of the community. This information would be helpful in predicting future community structure, energy flow and arriving at an environmental quality index.

The physical condition of the community is characterized by the organisms present. Conversely, certain species, or ecological indicators, are representative of particular environmental states. Saplings and small trees such as sumac (Rhus), aspen (Populus,) and cedar would indicate the area is in early developmental stages of secondary succession. A number of very large trees would suggest a mature or possible climax forest. The researcher should be aware of possible ecological indicators.

An ecotone is the interface where two diverse communities (such as a field and woods) meet.

The econtone length for the entire township was measured with a topographic map reader. This device traces the desired ecotone lines and records the distance in miles. The expression "edge effect" is the same as ecotone and it is usually characterized by increased variety and density.

Findings and Discussion

Twenty quadrats in fifteen locations were studied. A total number of twenty-three species were found. As indicated by the cumulative species: area curve (Figure 4) the graph levels off between quadrats 14-18 and no further field research was necessary.

Oak (Quercus) had the highest frequency at 95% followed by maple (Acer) and black birch (Betula Lenta) at 65% each. All other species were less frequent than 20%. Although frequency represents the percentage of species found per quadrat, it may not be indicative of the species' value to the community. Basal area better represents the energy flow that is occurring within the community.

Basal area was calculated using the formula for the area of a circle πr^2. The results are compiled in Table 5.

The species representing the greatest percentage of basal area is black birch at 49.62%. All species of oak accounted for 42.10%. Of the thirteen species left, only two, red maple and big tooth aspen, had values of over one per cent; 2.07% and 1.23%, respectively. These figures illustrate the fact that although many species are present, only a few have a significant effect on the flow of energy within the community.

The botanical analysis of Greenwich Township involved a total number of 309 trees. Black birch composed the largest number with 26%. Of the remaining 74% of trees, values of under 4% were reached for the last 70%.

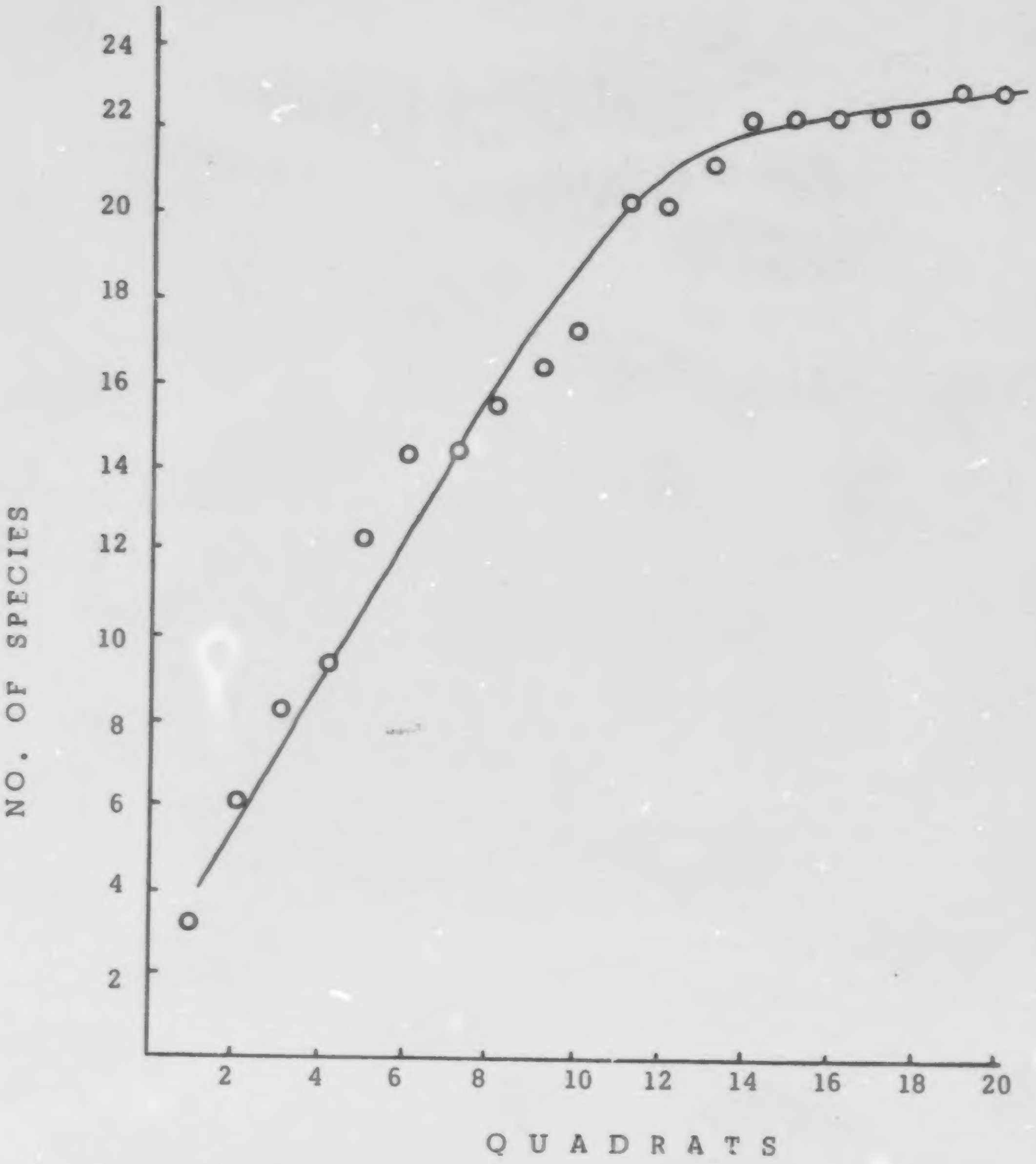

Figure [illegible]. Cumulative Species: Area Curve. The cumulative species are recorded with each quadrat study. Although the curve has started to level off, it would continue to climb slowly for an indefinite number of additional quadrats. The species so added would be the more numerous, but less common species. The curve would have climbed much higher if additional environmental areas of the township were studied, such as river flood-plains, early field seres, etc.

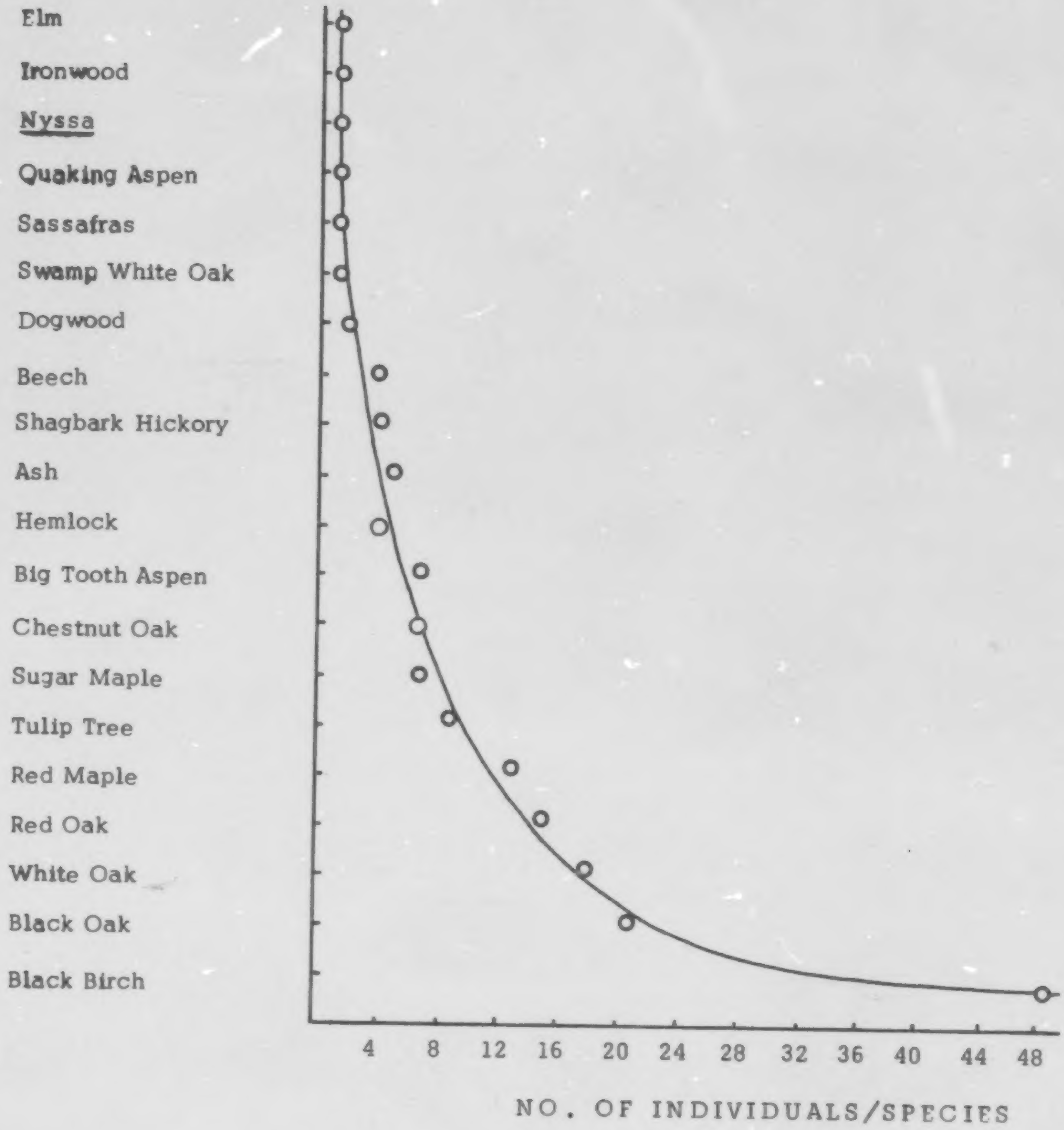

Figure 17. Relationship between the number of species and the number of individuals per species (N/S). "Rigorous physical environment, pollution, or other stresses will tend to flatten the curve" (Odum, 1971).

Table 2. Quadrat Studies of all trees 4" d.b.h. or larger
Twenty quadrats were studies. Each quadrat was
5 x 20 m (100 m^2).

Tree Species	Quadrat																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Elm					7															
Ironwood		4																		
Nyssa		6																		
Quaking Aspen				4																
Sassafras													5							
Swamp White Oak									5											
Dogwood									4					5						
Beech										12		4				6				4

Tree Species	Quadrat																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Shag-bark Hickory					10, 6,7															
Ash	4,5 4																			
Hemlock			7,8	8							4,4									
Big Tooth Aspen	8,8 6			6								4,5 7								
Chest-nut Oak			5									12	4,4 5,4 4							
Sugar Maple											4,4		4,4	5,4 4						
Tulip Tree														4,6			15, 11, 15		12, 13	8,9

Tree Species	Quadrat																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Red Maple	4	5,5	5	4			5		5,4	4	4				4		4			4
Red Oak	6,6	5,4	4,7 8,7 6,5 9,7	6,7								6								
White Oak						6,7 7	43		8,7 5,7				4,4		8	4,4 5	11,8		4	4
Black Oak					8,13			10,7 9,9 10	11, 10	9,13			4	8,10	9		7,10		4	8,7 8,8 8
Black Birch						5,6 4,6 6,6 5,5 7,5,7	5,4	7,9 9,9	4,5 8,5	6,4 5	5,6	4,6 4,4 5,5 5,6 5,6	6	6,6 5	4	7,4	7,9 8,8 7,7 5		4	
Unknown 1											5									
Unknown 2											6,6 6									
Unknown 3																			6,5	

Table 3. Distribution of species by slope direction. The North slope list is biased somewhat because more samples were taken in this category (see text).

SPECIES	Direction			
	North	South	East	West
Elm	X			
Ironwood	X			
Nyssa	X			
Quaking Aspen	X			
Sassafras				X
Swamp White Oak		X		
Dogwood	X	X		
Beech	X	X		X
Shagbark Hickory		X	X	
Ash	X		X	
Hemlock	X			
Big Tooth Aspen	X			
Chestnut Oak	X			X
Sugar Maple	X			X
Tulip Tree	X	X	X	
Red Maple	X	X	X	X
Red Oak	X			
White Oak	X			
Black Oak	X	X	X	X
Black Birch	X	X	X	X
Unknown 1 (Yellowwood?)	X			
Unknown 2 (Mulberry?)	X			
Unknown 3 (Birch?)			X	

Table 4. Average slopes (in degrees) of the various quadrats.

Quadrat Number	Slope, degrees
1	28
2	28
3	20
4	20
5	21
6	12
7	12
8	3
9	8
10	21
11	25
12	18
13	21
14	4
15	14
16	23
17	8
18	14
19	28
20	21
Average	+17°

Table 5. Basal areas of the trees.

SPECIES	BASAL AREA (in.^{2})	% TOTAL AREA
black birch	61105.	49.62%
black oak	27157.	23.06%
white oak	16733.	13.59%
red oak	6789.	5.51%
tuliptree	2461.	2.00%
big tooth aspen	1519.	1.23%
chestnut oak	1133.	0.92%
ash	803.	0.65%
hemlock	754.	0.61%
sugar maple	706.	0.57%
shagbark hickory	572.	0.46%
beech	560.	0.43%
Nyssa	113.	0.09%
dogwood	63.	0.05%
ironwood	50.	0.04%
elm	38.	0.03%
sassafras	19.	0.02%
swamp white oak	19.	0.02%
quaking aspen	12	0.01%
TOTAL		100. %

The genus Quercus (oak) had the highest average diameter of 7.0 inches, while the total average of 309 trees was 6.5 inches. The largest tree recorded was a white oak of over 40 inches d.b.h. The tree is located along the roadside of quadrat #7. The adjoining stand of trees had an average diameter of 6.5 inches, suggesting that the white oak for some reason has been preserved.

Monk (1967) has classified the climax forest of the Piedmont area as predominantly oak and chestnut. Logging activities once cleared the area of sizable trees leaving only the smaller oak and chestnut behind. All the chestnut has since been eliminated as a result of the chestnut blight of the early 1900's. The generally larger diameter of oak present today, aspostulated by the authors, could be due to the head start these oaks had over the newly established species characteristic of secondary succession such as black birch and red maple.

Species diversity $(\bar{H})$ was calculated by S.S. = $P_i \log P_i$, and determined to be 1.66. Monk had determined the index value for species diversity for northeastern Pennsylvania to be approximately 2.34.

The apparent different can be explained by the habitats studies and the sizes of the areas. Monk's figure was calculated mostly from climax forests. However, the heavy lumbering activities occurring over the past few decades has reduced most of the virgin stands to secondary growth. Secondary succession is an unstable stage of development and is characterized by a lower species diversity. If the woodlots present today were allowed to develop over the next 100 (or more) years, the representative developmental species would die and a climax forest of greater diversification would result. Diversity also goes up as the area sampled increases.

According to the authors estimation the tree population averaged twenty to forty years old. Beside the single forty-inch d.b.h. white oak tree, no other fully mature trees were noted.

A figure of .040 was calculated for the index of dominance. This number is a comparatively low value indicating a low level of dominance. According to this, no one (or very few) species in the community is controlling it. This supports the results from the basal area calculations which suggested that a number of oak species and black birch were fairly dominant.

Characteristic understory species were similar to those listed by Grim and Whitebread. Dogwood, mountain laurel, marginal shield fern, and christmas fern were commonly found. Many of the older, more developed sites had relatively little understory growth and ground cover. Shading and competition for nutrients were the limiting factors.

Intuitively, a definite similarity between quadrats was evident. Using the similarity index suggested by Odum as listed in Table 1 did not offer satisfactory results as there were too many entries involved in using the formula. The slope of each quadrat and the direction in which the quadrat faced were variables which could not be adequately compensated for since the samplings were predominantly north facing and slopes varied a great deal. The formula considers only the number of species present and not the number of trees within each species. If this factor along were taken into consideration, the values for the similarity index would be more meaningful.

Over half of the quadrats were located on slopes greater than (or equal to) 20°. Largely, only the land that was not suitable for farming (and/or served as wind-break) remains forested. The majority of quadrats were taken on Northern slopes simple because forested northern slopes were most prevalent. Northern exposures in the northern hemisphere are subject to colder temperatures than slopes facing other directions. Areas such as these are less desirable for farming. Climatic factors must be considered when comparing vegetation on different slopes. Hemlock seemed more prevalent on the cooler, damper, northern facing slopes.

The total amount of ecotone (available to the scale accuracy of a 7.5 min. topographic map) was determined to be 153 miles for the township. Although no figures are available with which to compare the findings, inspection of the township would indicate that the amount of ecotone is quite high. The whole township is dotted with small woodlots and any increase in "patchiness" (over an otherwise homogeneous area) multiplies the ecotone length. For Greenwich Township the length of ecotone/mi^2 was determined to be approximately 5 miles ecotone/mi^2 of township.

Ecotones are sites characterized by high species diversity since the area is comprised of actually three or more habitats. The obvious habitats present are those two diverse communities which are meeting, while the third is the habitat of those organisms benefiting from both and may be a common species only when both of the other habitats are present. Therefore, Greenwich Township should have a high diversity of certain animal populations, especially birds. The diversity effect is particularly pronounced when the junction is rough (i.e., not a sharp, straight-line cut) and the vertical stratification is gradual. An appreciation of the positive impact ecotones can have on the environment can be obtained from any of the several citations. (Egler, 1954; Johnston, 1947; Lay, 1938; and general ecology textbooks).

A summary of the findings are included in Table 6, along with some interpretive comments. It is in the context of these findings (which can be broadly interpreted as indices of environment quality), the context of an ecological planner (McHarg, 1969) and the context of a suggested model of ecosystem compartmentalization, that the general recommendations follow.

Table 6. A summary of the environmental quality findings with a synopsis of the environmental implications.

ATTRIBUTES	FINDINGS	COMMENT
1. Dominant autotroph sizes		Wooded upland areas largely second-growth dominated by oak, as reported elsewhere (Braun, 1972). Not an unusual condition. Continued tree growth will add contribution of forests to the township.
a. Avg. diam.	6.5"	
b. Highest avg. diam	7.0" (oak)	
c. Max. diam.	+40. " (wh. oak)	
d. Basal area	Birch 49% Oak 42% Other 9%	
2. Indices		Diversity not particularly high and dominance not narrowly concentrated. No evidence of extreme stress. Satisfactory.
a. species diversity	1.66	
b. index dominance	.040	
c. S: (N/S)	(see Fig. 5)	
3. Species Frequency		As in 1(above), oak-dominated, and typical situation based on broad findings elsewhere. Birch frequency not clear.
a. Maximum freq.	oak, 95%	
b. next	maple, 65% birch, 65%	
4. Slope		The many small woodlots are too steep for heavy agricultural use. Cutting of woods could present extreme erosion conditions.
a. most common	N. facing	
b. Range, degrees	$1 - 30^{\circ}+$	
c. common	$\geq 20^{\circ}$	
5. Ecotone		Favorable ecotone situations.
a. total length	153 miles	
b. length/mi^2	~ 5	
6. Virgin climax forests	none	Desirable, but rare phenomena. Some of the current woodlots should be set aside in perpetuity so that mature climax forests can evolve.

Recommendations

Greenwich Township enjoys proximity to metropolitan areas while enjoying the atmosphere of an agricultural and rural countryside. Woodlots, while small and quite numerous, are characterized by birch-oak-dominated second-growth hardwoods with occasional stands (natural and/or plants) of evergreen. Most upland wooded areas are on North-facing slopes. Botanically, the wooded areas are not unique, but rather quite like that of much cf the former oak-chestnut forest. Specific ecosystem attributes of typical upland wooded areas are included in Table 6.

Most of the township land is currently in the productive-developmental category. The wooded areas are evolving toward the mature category. On a comparative basis, the urban-industrial and compromise categories are small in the township, but "growth" and "progress" usually means a continued deletion of the mature categoty _to_ either of the latter two. Figure 18 illustrates the basic kinds of environment.

In consideration of the inputs available, the following broad recommendations are made:

1. Serious consideration be given to retaining as much of the wooded land intact as possible.
2. Wooded areas under consideration (pressure?) for development be judged in the context of the attributes generated by this study (summarized in Table 6). Areas with more valuable forest cover should be preserved as a general township resource.
3. Parties claiming "unique areas" should be in a position to compare the same with the general findings. In consideration of this point and that of point 2 (above), the present study might serve as a gauge for measurement.
4. Wooded areas having a distinctive character or flavor, as the scattered evergreen stands (as in the Dietrich Bridge) should be retained and/or carefully managed. They add a pleasant variety to the predominantly hardwood forest environment.

5. Ecotones should be treated as a positive contribution to the diversity and wildlife of the township.

6. Broad guidelines for future planning in the township be considered in the context of the Compartment Model (Figure 18). Removal or deletion of the mature-protective category, while ear-marked for economic gain, will cost in environmental losses.

7. Development of land for housing be considered within the context of an ecological planner's views which include (after McHarg, 1969) that -- valleys without forests be planted over and not developed; that wooded slopes of 25% (or less) have a maximum development of 1 house/3 acres; that wooded slopes exceeding 25% not be developed; and that wooded plateaus be developed to a maximum of 1 house/acre. The citation is a strongly recommended reference.

8. It is acknowledged that this report is, of necessity, brief and suggestive of a more comprehensive study from which the township could profit greatly. Consideration should be given to more detailed studies -- the cost of which will be minimal for the future environmental gains to be reaped from such an endeavor.

9. Finally, it is recommended that the inputs of this study be joined with the other studies in the form of a multi-overlay map series so that the township can be viewed in its totality, and from which the most sound decisions and planning can be made.

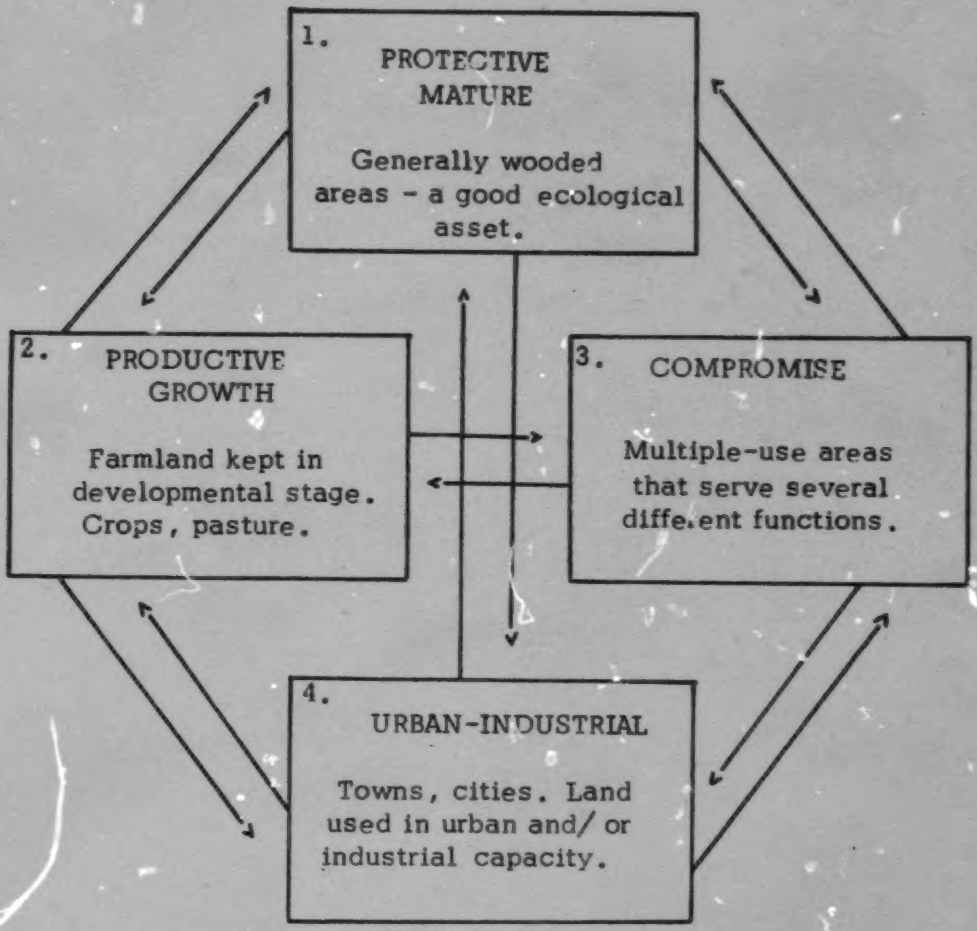
1.
PROTECTIVE
MATURE
Generally wooded areas - a good ecological asset.
2.
PRODUCTIVE
GROWTH
Farmland kept in developmental stage. Crops, pasture.
3.
COMPROMISE
Multiple-use areas that serve several different functions.
4.
URBAN-INDUSTRIAL
Towns, cities. Land used in urban and/ or industrial capacity.

Figure 18. Compartment model of basic kinds of environments (after Odum, 1971). "Progress" generally shifts the land from categories 1 and 2 to 3 and 4.

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MACRO-INVERTEBRATES OF THE SACONY AND MAIDEN CREEK WATERSHEDS

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March 22, 1974

ABSTRACT

Macro-Invertebrates of the Sacony and Maiden Creek Watersheds

This study involves a thorough examination of the macro-invertebrates and selected physical parameters. Qualitative samples of Benthic-invertebrates were obtained with a plankton net seine (0.5 mm mesh), a modified Surber sampler (Wildlife Supply Company, number 12) and random selection of larger rocks and boulders and hand gleaning. Three sampling stations were established on Maiden Creek, five on the Sacony Creek, and one on Mill Creek. One thousand five hundred seventy-two specimens comprising thirty-one families of invertebrates were taken. The tributaries to the Maiden Creek showed the richest diversity and the organisms collected were largest and appeared in best condition at these locations.

MACRO-INVERTEBRATES OF THE SACONY AND MAIDEN CREEK WATERSHEDS

INTRODUCTION

An aquatic study of the Maiden and Sacony Creek Watersheds in the vicinity of Greenwich Township, Berks County, Pennsylvania was conducted as part of an intensive study of the total environment surrounding and including Greenwich Township. This study involves examination of the macro-invertebrates and selected physical parameters of the various creeks.

METHODS AND MATERIALS

Qualitative samples of Benthic-invertebrates were obtained with a plankton net seine (o.5 mm mesh(, a modified Surber sampler (Wildlife Supply Company, number 12), and random selection of larger rocks and boulders and hand-gleaning. An Eckman dredge was employed at several locations. The dredge proved ineffective where substrate was other than mud. Specimens were preserved in a 70% solution of Isopropanol. A saturated NaCL solution was used after the removal of larger macro-invertebrates to lift lighter invertebrates to the surface. Organisms were rough-sorted to order and placed in 40% Isopropanol. They were then sorted to families.

Identifications were made by using standard keys from : Pennak (1953), Usinger (ed., 1959), Ward and Whipple (Edmonson, ed., 1959); other specific references are cited herein.

Physical water data were obtained with a Hach oxygen analyzer Model OX2P, Hach PH indicator Model 17F, and standard field thermometer.

DESCRIPTION OF STATION

Three sampling stations were established on Maiden Creek. Spring Run (Station One) - Located above Zettlemoyer's Bridge. An area about 3 feet wide and 100 feet long was sampled. It was primarily riffle and run from 2 to 6 inches deep with pools from 1 to 2 feet deep located adjacent to the banks and under a gravel road culvert. The bank here was wooded.

Zettlemoyer's Bridge (Station Two) - Located along Pennsylvania Route 143 approximately 2 miles north of Lenhartsville, Pennsylvania. The area sampled was about 150 feet wide and 300 feet long and contained a large riffle with rubble bottom and an extensive run. The latter contained beds of Potomageton and Vallisinaria. A backwater and two small pools were also sampled; the bottom in each was primarily sand and gravel. The banks were partially wooded with massive sycamore trees.

Maiden Creek confluence with Sacony Creek (Station Three) - Located about 1/2 miles north of the town of Virginville, Pennsylvania and the same distance north of the actual confluence was a shallow area of extensive riffles and runs in the Maiden Creek. The area sampled was approximately 75 feet wide and 200 feet long. Small patches of Myriophyllum were present in riffles and runs. The banks were again sycamore lined.

Heffner's Bridge on the Sacony Creek (Station Four) was located 2 creek miles east of the village of Virginville, Pennsylvania. The station consisted of an area approximately 30 to 40 feet wide which extended 50 feet above and below the bridge. It included a large shallow pool under and above the bridge with runs, riffles, and small pools downstream. The bottom throughout was gravel, rubble, and boulders covered by a thin layer of silt. Many barn swallows were noted in the area.

Schleiner's Run, tributary to the Sacony Creek (Station Five), was located 1/2 road miles north of Heffner's Bridge along an unspecified legislative route. Area sampled was located in the headwaters of this small spring run. The area sampled was approximately 6 feet in width with adjoining steep banks next to the legislative route. The stream above the sampling station meanders through a grazing field. Large metallic-green damselflies (Green darners) were in great abundance.

Station Six was near the Sacony Bridge on the main Sacony Creek. The sampling station was located downstream of the bridge approximately 125 yards. The station sampled had a rubble bottom with much silt and the water was quite turbid. Width of the stream at Station Six was approximately 30 feet. A sampling to a depth of 12 inches was taken. Water in other areas of the stream was high. This station showed evidence of being used by fishermen by the presence of discarded packages of hooks, sandwich wrapper debris, and beverage cans. Some dead sunfish (Lepomis sp.) were noted along the bank.

Heinly Bridge, tributary to the Sacony Creek (Station Seven), was located north of Pennsylvania Route 737 in an area of numerous summer picnic grounds and sportmen's camps and approximately 2 creek miles north of the juncture of highway 737 and Mill Creek (tributary to the Sacony Creek). The stream had a rubble to rocky bottom and rocky, sycamore-catalpa banks. The area sampled was located downstream approximately 45 yards from Heinly Bridge. There was evidence of detergent effluent in the water by a build-up of foam at stream constrictions.

Sacony Creek below large stone dam (Station Eight) was a run-riffle area along the main Sacony Creek along a dirt road (unmarked) which runs parallel to Pennsylvania 737 approximately 2 road miles south of the conjunction of 737 with the aforementioned Mill Creek. The water in the sampling area was quite turbid and ran to a depth of 23 inches with a stream width of 35 feet. Many boulders and rubble were found in the stream. High banks west of the sampling stations were contaminated by mounds of decaying garbage and rubbish from old dumping sites. There was high water prior to the last sampling which was preceded by heavy rains.

Station note -- Station number 5 and 8 had two collecting locations and will be designated 5 a and b and 8 a and b. This was a matter of methodology and had nothing to do with stream differentiation or topography.

RESULTS

1. Ten areas were sampled in the Maiden Creek/Sacony Creek Watersheds in July. Three collections were made in the spring and summer of 1973. Only the July collection is reported herein due to the conditions of the stream with high water and thus a lack of standardization.
2. Several sampling methods were employed for qualitative purposes.
3. 1,572+ specimens and 31 families of invertebrates were taken.
4. Trichoptera was the most abundant order in the Maiden Creek.
5. The clam, Sphaerium, is abundant below all dams.
6. Families of invertebrates are constant in all stations while abundance within families differs widely from station to station.
7. The tributary of the Maiden Creek above Zettlemoyer's Bridge contained the greatest variety.
8. Micro-habitats, particularly rich in Tendipedidae, were found on submerged aquatic vegetation.
9. The tributaries to the Maiden Creek showed the richest diversity and the organisms collected were largest and appeared in best condition at these locations.
10. The Maiden Creek system appeared to be the stream of highest quality.

Table 7. Families of Invertebrates collected in the watershed of the Sacony and Maiden Creeks, Greenwich Township proper, Berks County, in July 1973.

	1	2	3	4	5a	5b
Collection Number	JJB 23	JJB 24	JJB 25	JJB 26	JJB 27	JJB 27
Month	July	July	July	July	July	July
Day	15	15	15	16	16	16
Hour	0900	0945	1045	0830	0930 Qual.	1000 $(ss^2)^1$
Air Temp. (F)	70	70	76	72	70	72
Water Temp. (F)	60	66	70	64	65	65
Oxygen Concentration. (ppm)	9	10	13	14	9	9
H-ion Concentration. (pH)	7	7.5	8.5	8.5-9	7.0+	7.0+
Number of Specimens	88	113	133	252	240	59
Families of Invertebrates	8	5	11	11	14	
Aquatic earthworms						
Tubificidae						
Enchytraeidae						
Lumbricidae			7			2
Hirudinea						
Glossiphoniidae			1	2		
Turbellaria						
Planariidae				70+		
Isoptera						
Asellidae					43	13
Crayfish, shrimp						
Astacidae			3	7	16	4
Mayflies						
Baetidae	6	19	17	8		
Heptageniidae	4	39	5	9		
Ephemeridae			2			
Dragonflies, damselflies						
Coenagrionidae					2	
Aeschinidae					1	
Libellulidae						
Bugs						
Nepidae				43	31	
Gerridae				17	13	
Caddisflies						
Hydropsychididae	28	46	53	64	39	21
Philopotomidae						
Rhyacophilidae	2					
Stone Flies						
Perlodidae	3					
Beetles						
Elmidae	36	7	23	82		
Psephenidae		2	9			
Hydrophilidae			3			
Dryopidae					2	
Flies, midges, mosquitoes						
Tendipedidae				8	23	1
Tipulidae	2					
Simuliidae	7				68	15
Anthomyiidae					1	
Syrphidae					1	
Snails						
Physidae			9		31	3
Clams						
Sphaeridae				7		

Table 8. Families of Invertebrates collected in the watershed of the Sacony and Maiden Creeks, Greenwich Township proper, Berks County in July, 1973.

	6	7	8a	8b
Collection Number	JJB 29	JJB 30	JJB 31	JJB 32
Month	July	July	July	July
Day	16	16	21	21
Hour	1100	1200	1430	1500
Air Temp. (F)	72	75	72	72
Water Temp. (F)	64	70	63	63
Oxygen Concentration (ppm)	10	12	10	10
H-ion Concentration (pH)	8	8.5	8.5	8.5
Number of Specimens	330	209	94	54
Families of Invertebrates	9	12	5	
Aquatic earthworms				
Tubificidae			4	
Enchytraeidae	5			
Lumbricidae				
Hirudinea				
Glossiphoniidae				
Turbellaria				
Planariidae				
Isoptera				
Asellidae			31	3
Crayfish, shrimp				
Astacidae		21	27(Gammaridae)	6
Mayflies				
Baetidae	48	35		
Heptageniidae	19	14		
Ephemeridae		3		
Dragonflies, damselflies				
Coenagrionidae				
Aeschinidae				
Libellulidae	2	2		
Bugs				
Nepidae				
Gerridae	53	12		
Caddisflies				
Hydropsychidae		57	12	4
Philopotomidae	68			
Rhyacophilidae				
Stone Flies				
Perlodidae				
Beetles				
Elmidae	69	79		
Psephenidae	42	35		
Hydrophilidae				
Dryopidae				
Flies, midges, mosquitoes				
Tendipedidae	24	25	21	13
Tipulidae		5		
Simuliidae				
Anthomyiidae				
Syrphidae				
Snails				
Physidae				
Clams				
Sphaeridae				28
Ancylidae		4		

STUDY OF FISH LIFE

by

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January 30, 1974

ABSTRACT

A Study of Fish Life

A study of the fish life of the Sacony, Mill, and Maiden Creeks in Greenwich Township, Berks County, Pa., was conducted from February, 1973, to November, 1973. Chemical and physical data were collected in addition to biological data. Techniques employed included seining, visual observation, hook-and-line captures, and use of LaMotte chemical test kit. A total 119 individual fish were captured at five stations in the three streams. These individuals were identified as belonging to 13 genera and representing 18 species. The Sacony Creek was determined to have the greatest variety; Mill Creek, the least. In general, all fish captured were small, less than 10 centimeters (four inches), and there was a conspicuous absence of game-fish.

STUDY OF FISH LIFE

Introduction

An assessment of the fish life of the Sacony and Maiden Creeks, in Greenwich Township, Berks County, Pennsylvania, was conducted as part of the Greenwich Township Environmental Analysis (GTEA). The objectives of the fish study, in addition to the objectives stated by GTEA, was to determine what kinds of fish could be found in the township. The study of fish began with preliminary visits to the streams in February, 1973, and all field work was terminated in November, 1973.

Description of Streams

Maiden Creek is a tributary of the Schuylkill River. A three mile section of the stream running north to south across the western corner of Greenwich Township (in north-central Berks County) was studied. The origin of the stream lies north of Greenwich Township in the metaquartzite Blue Mountain complex. Most of the stream bed lies in shale, quartzite, and limestone, characteristic of the region. The stream is relatively wide and shallow with low banks bearing trees. Due to the width and shallowness of the stream (See Table 10), the trees along the banks afford little overstory cover. The flood plain of the stream is populated by active and inactive farms and scattered cottages. The stream bed is characterized by fist-size shale, sand, and gravel, with some scattered boulders in riffle areas. The flat, shale bottom offers little cover for fish life, especially during low water in winter and late summer. Stream flow in general can be classified as lotic (See Table 10 for depth, velocity, volume, and chemical parameters).

The Sacony Creek is a tributary to Maiden Creek, the two joining in the southwest corner of Greenwich Township. The Sacony flows along and forms most of the southern boundary of the township. The creek originates in the igneous Reading Prong geological feature to the east of Greenwich Township, flows through extensive farming areas and the borough of Kutztown, Pa., before entering Greenwich Township. Approximately three miles of the stream were involved in the study. The stream bed lies in limestone, quartizite, sandstone, and some igneous rock. The stream is narrower and deeper than Maiden Creek (See Table 10). Trees along the banks afford cover from almost no shading to approximately fifty percent covered. The stream bed is characterized by shale and numerous deep pools. Many of these deep pools bear smooth shale bottoms, thus limiting their effectiveness as fish cover. Stream flow in general can be classified as lotic (See Table 10 for depth, velocity, volume, and chemical data).

Mill Creek is a small tributary to the Sacony Creek, located in the eastern portion of Greenwich Township. With the exception of its smaller size, the major geological features of the stream are similar to the Sacony Creek within Greenwich Township. The Creek, however, does not pass through as intensively farmed land as does the Sacony. Mill Creek's banks are in places heavily wooded. The stream is shallow with numerous deep pools. In general, stream flow can be classed as lotic (See Table 10 for depth, velocity, volume, and chemical data).

Procedures

Water analysis was conducted at the stream sites (See Table 9). Chemical and physical measures, via LaMotte test kits, were taken. Chemical measures included O_2, alkalinity, hardness (Ca and Mg hardness), and pH. Physical measures included rough observations of general substrate conditions and surrounding environment. Measures were taken concerning stream depth and rate of surface flow (Table 10). Computations using Needham's (1962) formula were made to determine mean volume of stream flow.

Biological data, fish captures, were obtained by employing techniques available to the layman (in conformity with the established objective of the GTEA study - to explore and/or develop techniques available and useable by the layman). Fish captures were effected by seining, visual observation, and hook and line technique. Chemical poisons were not employed in order to reduce damage to local ecosystems. Electrofishing and electronic equipment were not employed since such sophisticated methods are not generally available to the layman as well as useable by the layman.

In addition to the above, morphometric data for each fish were obtained along seven dimensions: total length, standard length, depth of body, snout, nape, orbit and weight. Select individuals were retained for additional more detailed analysis (not included in this report).

Results

Table 9. Stream Sampling.

Stream	Maiden Creek		Sacony Creek		Mill Creek
Sample site	A	B	Campgrounds	Bend	A
Stream physical data collected	1*	2	1	1	2
Fish collecting	2	1	1	2	1

*Note: Units are number of days or visits during which data were collected.

Table 10. Summary of Water Characteristics.

Stream Site	Maiden "A" June 28	Maiden "B" Nov. 24	July 16	Sacony Cpg. May 17	Sacony "B" Nov. 24	Mill "A" July 23*
pH	7.9	7.8	8.0	8.0	7.8	8.0
O_2	7.1ppm	13.5	9.6	12.4	12.8	8.0
CO_2	5.0ppm	No data	1.3	0.0	No data	1.5
Total Alkalinity	36.0ppm	No data	30.0	77.5	No data	12.0
P-alk.	0.0ppm	No data	0.0	No data	No data	0.0
M-alk.	34.0ppm	No data	30.0	No data	No data	12.0
Total Hardness	65.0ppm	60.0	54.0	160.0	126.0	18.0
Ca. Hard.	20.0ppm	34.0	30.0	No data	92.0	12.0
Mg. Hard.	45.0ppm	26.0	24.0	No data	34.0	6.0
Salinity	0.3ppt	Less than 0.6	0.4	Less than 1.0	Less than 0.6	0.8
Temperature in Centigrade	24.2	8.0	23.1	14.0	8.0	25.0
Mean width	No data	18.0m	25.2	13.2	12.0	8.0
Mean depth	No data	38.6±9cm	25.6±19	32.3±19	23.8±8	8.5±5
Mean surface velocity	No data	25cm/sec	38.5	65.8	27.1	35.7
Mean volume	No data	$1.4m^3$/sec	2.0	2.3	0.6	0.2

*Note: Mill Creek "A" was visited on July 18, fish taken but no stream characteristic data.

Table 11. Number of Fish Taxa and Number of Individuals Collected.

	Genera	Species	No. of Individuals
Maiden Creek	9	11	63
Sacony Creek	10	13	44
Mill Creek	4	4	12
Totals	13*	18*	119

*Note: Several genera and several species were found in more than one stream. Therefore these two figures do not represent the sum of the above columns, rather, they reflect the total number of different genera and species across all streams.

Table 12. Summary of Fish by Genera, Species, Stream and Numbers.
(For Table 12, See page 101)

Discussion

By virtue of the sampling technique employed, the water characteristics data obtained are somewhat "spotty." However, several significant factors can be identified. (See Table 10.)

Acidity, or pH, is well known to influence fish life. All three streams studied indicated a slighly alkaline situation, especially the Sacony Creek, pH = 8.0. According to Reid (1961), this pH value is not uncommon in streams lying in lowland, limestone areas.

The level of Oxygen, a critical factor, does not appear to present a serious problem in the three streams. The oxygen levels, ranging from 7.1 ppm to 13.5 ppm, are, in general, adequate to support fish life. However, this study did not obtain daily records of O_2 levels for all seasons. Thus, seasonal or daily fluctuations may be critical, especially during the low, warm water summer season.

Alkalinity and Hardness measures indicate the greatest difference among the

Table 12. Summary of Fish by General, Species, Stream and Numbers.

Name	Maiden Cr.	Sacony Cr.	Mill Cr.	Total
Ambloplites rupestris Rockbass		1		1
Catostomus commersoni White sucker		2	1	3
Chrosomas erythrogaster Redbelly dace		1		1
Etheostoma nigrum Johnny darter	1	1		2
Exoglossum maxilingua Cutlips minnow	2	2	1	5
Ictalurus nebulosus Brown bullhead	1			1
Lepomis auritus Yellowbelly sunfish	5			5
Lepomis gibbosus Pumpkinseed	1			1
Micropterus dolomieui Smallmouth bass	2			2
Micropterus salmoides Largemouth bass	3			3
Notemigonus crysoleucas Golden shiner	2	2		4
Notropis cornutus Common shiner		2	2	4
Notropis whipplei Steelcolor shiner	3			3
Pimephales notatus Bluntnose minnow		1		1
Rhinichthys atratulus Blacknose dace	14	19	5	38
Rhinichthys cataractae Longnose dace		1		1
Semotilus astromaculatus Creek chub		4		4
Semotilus corporalis Fallfish	8	4		12
Unidentified	21	3	3	27
			Total	119

streams. Mill Creek contains the lowest amount of dissolved ions; total alkalinity = 12.0 ppm, total hardness = 18.0 ppm. Maiden Creek with total hardness ranging from 54 ppm to 65 ppm and total alkalinity ranging from 30 ppm to 77 ppm contains approximately three times the amount of dissolved ions compared to Mill Creek. Lastly, the Sacony Creek carries the greatest load of dissolved ions. Total alkalinity was measured in the Sacony on May 17 at 77.5 ppm and total hardness was measured on May 17 at 160.0 ppm, more than double the amount in the Maiden Creek and approximately ten times the amount carried by Mill Creek.

These differences in the amounts of dissolved ions are not surprising in light of the fact that the three streams originate and flow through different substrates. High amounts of dissolved matter can be expected in lowland, limestone areas. However, the proximity of the Mill Creek drainage area to the Sacony drainage area suggests that a difference in dissolved ions by a magnitude of ten times may not be entirely justified by differences in substrate environments. It is suspected that a large portion of the ion load of the Sacony is the result of intensive farming (perhaps over-fertilization) in its drainage area. Since much of the Sacony drainage area lies outside of Greenwich Township, the differences between the Sacony and Mill Creeks and the effects of farming and the borough of Kutztown should be investigated in a study not restricted to Greenwich Township.

Temperature seems to present the most critical limiting factor in these streams. It is suspected that if daily summer data are obtained, the high temperatures recorded in this study (Maiden Creek, 24.2°C.; Sacony Creek, 23.1°C.; and Mill Creek, 25.0°C.) would be exceeded. These temperatures are well above optimum ranges for certain fish such as trout. Optimum temperature alone accounts for the absence of trout in these waters. It is believed the temperature range in the Sacony Creek could be improved by allowing tree cover to grow in many areas where trees have been removed, especially in farm areas. Maiden Creek may be too wide and shallow for additional tree cover to be effective.

The Sacony and Maiden Creeks seem to be well supplied with a variety of fish. Of the two streams, the Sacony seems to have the greater variety. Less individuals (44) were taken from the Sacony, yet a greater number of genera (10) and species (13) were found compared to the Maiden Creek (63 individuals yielded 9 genera and 11 species).

It is disappointing to note, however, that within this seeming richness in variety, the fish captured and those seen but not captured were all small. Most of the fish were of the minnow and shiner variety, less than ten centimeters (four inches) in length. The only "gamefish" caught, the largemouth and smallmouth basses, were all under the legal limit of nine inches. Also, the fish were concentrated in a few small pools and riffles. Large stretches of both the Maiden Creek and Sacony Creek were devoid of any fish life. It is suspected that unless there are toxic trace elements in the streams this sparsity in distribution and small size of all fish is directly related to the lack of adequate protection. It is the opinion of this author that both streams could be greatly improved simply by the construction of rock riffles and baffles. These obstructions would afford much needed hiding places for fish. Also, water flow over and around these obstructions would cause the development of more pools, deeper pools, or, in the case of the Maiden Creek, a much needed central channel. Both streams appear to be too smooth-bottomed to offer adequate protection for fish fry and adults.

Not enough sampling was conducted in Mill Creek to afford a comparison to the other two streams.

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WILDLIFE ANALYSIS

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ABSTRACT

Wildlife Analysis

Selected areas of Greenwich Township were searched for amphibians, reptiles, and non-game species of mammals. The main objective of these searches was to identify areas worthy of preservation as havens for wildlife of the types mentioned above. In order to utilize methods which could be used in the future by township residents, we relied only on visual observations and manual searches. No trapping techniques were employed. The township was partitioned into three horizontal sections for ease of reference in discussing the survey. A questionnaire was devised and mailed to township residents. This questionnaire provided additional information about the kinds and locations of wildlife observed by the residents. Fur dealers also provided useful information.

Our searches and other data indicate that the upper section of the township has the least diversity of wildlife. The area except for the rocky slopes of the western part is primarily farm land with little variation in habitat. The middle and lower sections have more varied habitats and a greater diversity of animal life. The presence of swamps, marshes, and ponds along the Maiden and Sacony Creeks are important in providing niches for this diverse assemblage of animals.

A checklist of amphibians, reptiles, and mammals of Greenwich Township is given. The surveys of Poole and Roberts and Early were used for the mammal distributions; the books by Conant, Netting, Richmond, and Whitaker provided the best information available for gauging the distribution of amphibians and reptiles. An estimate of population levels of the species in the checklist is presented also. Possible future studies are suggested and a list of areas which should be preserved as wildlife refuges is indicated. These areas include the

flood plains along the Sacony and Maiden Creeks, the northwest corner of the township along the Kittatiny Ridge, the area around Camp Edmar, and areas north and northeast of State Game Lands No. 182. In our opinion, individual land owners can do much to provide suitable habitats for wildlife by maintaining wooded sections, marshes, farm ponds, etc. on their properties and planting appropriate trees and shrubs to attract wildlife.

WILDLIFE ANALYSIS

The main purpose for our participation in the Greenwich Township Environmental Analysis was to survey the township for areas which should be maintained as habitats for amphibians, reptiles, and non-game species of mammals.

We attempted to investigate most regions of the township where animals of interest might be found. Most of the animals in the groups investigated are secretive, seasonal in their appearance, and unpredictable. Because of the difficulties in locating specimens even after intensive searches we kept uppermost in our minds the identification and listing of suitable areas where wildlife would likely be observed under the right conditions. Searches were made at various times during the day and night. Where possible, the specimens were captured to make proper identification; however, only occasionally were specimens collected. Collected specimens are located in the collections of the biology department of Muhlenberg College.

To supplement our findings, we decided to construct a questionnaire designed to provide township residents the opportunity to indicate when and where they had observed animals of the groups of interest to us. We had hoped this questionnaire would be mailed in early fall so that hikers, hunters, and trappers could provide information they might gather during their excursions in the field during autumn. Unfortunately, mailing of the questionnaire occurred much later than we had planned. Nevertheless, ninety reports were returned and the information gleaned from these reports was helpful. We also consulted two furdealers in the area, Mr. Harry Adams of Edenburg and Mr. Sylvester Dietrich of Greenwich Township, for information about mammals trapped in the township.

For ease of reference in our field work, we partitioned the township into three horizontal sections. These sections are:

UPPER SECTION - the area bounded by Albany Township on the north, south to Rt. 22.

MIDDLE SECTION - the area south of Rt. 22 to the macadam road extending from New Jerusalem Church to Dietrich's Mill Bridge.

LOWER SECTION - the area south of Township road to the southern border of the township along the Sacony Creek.

For each section a general description of the environment is presented, followed by a list of observations from our field searches, and a summary of the information gathered from the questionnaires from that section.

UPPER SECTION

The area of the township north of Rt. 22 is primarily farm lands, wooded knolls, mountain slopes in the western edge, and a few swampy areas. The section seemed to be suitable for various non-game species as well as game species such as rabbits, pheasants, and woodchucks.

Field Searches

July 9, 1973 Searched from 10:00 a.m. to 2:00 p.m. along road cuts, shale banks, rock piles, and other sites specifically to locate snakes. No reptiles or other non-game species were seen, although numerous individuals of the game species mentioned above were seen.

Questionnaire Results - 23 Reports

Amphibians	10 salamanders were listed, no identification possible; frogs abundant. These were probably leopard frogs. Toads abundant, probably the common toad.
Reptiles	Garter snake, 25 Water snake, 5 Black snake, 1 Milk snake, 1 Cooperhead, 1
Mammals	Skunks and Possums, frequently seen alive and dead on road Raccoons and Muskrats, common Moles and Shrews, six reports from individuals with cats as pets which brought the moles and shrews into the owner's yard Grey Fox, 10 Red Fox, 10

Grey squirrels, chipmunks, bats, probably the little brown bat, were also reported several times.
Black bear, several reports noted the presence of a bear in the fields north of Rt. 22 between Lenhartsville and Krumsville during July and August.

One person noted that he had trapped one skunk and fourteen muskrats in the upper section of the township.

MIDDLE SECTION

The region south of Rt. 22 to New Jerusalem Church near the western edge of the township east to Dietrich's Mill Bridge near the eastern border has a variety of habitats for non-game species. Along the western edge, the flood plains of the Maiden Creek south of Lenhartsville are dotted with marshes and swamps. There are larger wooded tracts in the middle portion of this section than there are in other sections of the township. Interspersed with the woods are open fields and pasture lands. Meandering streams in the eastern sector also provide suitable habitat for wildlife.

Field Searches

March 30, 1973 7:30-9:30 p.m.	Spring peeper, heard large chorus	Covered Bridge, Maiden Creek
	Spring peeper, heard large chorus	Lenhartsville Pond
	Wood Frog, egg mass	Lenhartsville Pond
April 20, 1973 1:15-2:15 p.m.	Snapping turtle, 12", female	Lenhartsville Pond
	Snapping turtle, 13", male	
	Common toad, strands of eggs	
	Wood frog, egg masses	
	Leopard frog, 1, male	
April 20, 1973 2:30-3:30 p.m.	Water snake, 20", DOR*	New Jerusalem Church
	Garter snake, 18"	
June 7, 1973 10:00-11:15 a.m.	Red-backed salamanders, 7	Kohler's Hill
	Lead-backed phase of Red-backed salamander, 11	
	Northern dusky salamander, 8	
	Two-lined salamander, 1	
June 7, 1973 11:30-12:15 p.m.	Red-backed salamander, 2	Camp Edmar
	Eastern chipmunk, 2	

*DOR - dead on road

June 9, 1973	Spotted turtle, 1	Rt. 737 near Dietrich's Mill Bridge
June 11, 1973	Snapping turtle, 1 Common weasel, 1 Possum, 1	Rt. 737 near Dietrich's Mill
June 13, 1973	Snapping turtle, 2 (1, DOR)	Rt. 737
June 18, 1973	Snapping turtle, 1 Box turtle, 1	Rt. 737
July 16-23, 1973	Common toad, 24 young Green frog, 15 young Box turtle, 1 Garter snake, 1, DOR Racer, 1 Skunk, 1 Possum, 1	Robert Gray's yard and Ron Rhein's yard
Sept. 17-24, 1973	Brown (DeKay's) snake, 1 Garter snake, 1 (DOR), 24" Milk snake, 1 (DOR), 12"	Robert Gray's yard and Ron Rhein's yard
Oct. 12, 1973 2:00-4:30 p.m.	Garter snake, 1, 24" Red-backed salamander, 3 Lead-backed phase, 1	New Jerusalem Church along stream
Oct. 13-16, 1973	Box turtle, 1 Possum, 3 (DOR)	Rt. 737 between Three-Mile House and Kutztown Rod & Gun Club
Oct. 27, 1973	Possum, 1 Red fox, 1	Kohler's Hill
Nov. 1, 1973	Red fox, 1 (DOR)	Lenhartsville
Nov. 22, 1973	Possum, 1 Possum, 1	Rt. 737, Three-Mile House Robert Gray's yard

Questionnaire Results - 46 reports

Amphibians	15 salamanders reported, some identified as red-backed and lead-backed salamanders. Frogs and toads abundant, species not certain but most likely leopard frogs and common toad.
Reptiles	Garter snake, 15 Milk snake, 7 Black snake, 2 Water snake, 5 Copper head, 2 DeKay's snake Snakes, unidentified, 15

Box turtle, 18
Snapping turtle, 5
Spotted turtle, no numbers listed
Wood turtle, no numbers listed
Painted turtle, no numbers listed

Mammals

Skunk, possums, muskrats, and raccoons, abundant in section
Moles, shrews, bats occasionally seen, common shrew indicated and little brown and big brown bats also reported
Common weasel, 11, one observer reported a family of 6 weasels
Grey fox, 2-4
Red fox, 15-18, one family of red foxes along Maiden Creek
Grey squirrels and chipmunks, mentioned a few times

One trapper reported collecting 18 muskrats, 4 possums, and 1 raccoon. Another trapper listed 3 possum and 1 raccoon.

One questionnaire from Mr. Rhein contained most of the detailed identifications of wildlife of observations over a six year period.

LOWER SECTION

The southernmost region of the township from the township road (road from New Jerusalem Church to Dietrich's Mill Bridge) to the Sacony Creek, the southern border of the township already has a valuable wildlife area, State Game Lands, No. 182. In addition to the game lands which provide habitats for non-game species as well as game species, there are open fields, sparse woodlots, and swamps and marshes along the flood plains of the Sacony. An interesting cave exists near Old Dutch Mill Park.

Field Searches

March 30, 1973 7:30-9:30 p.m.	Common toad, heard calls and caught one male	Near State Game Lands
	Spring peeper, heard chorus	East of Virginville near covered bridge
April 20, 1973	Red-backed salamander, 18 Lead-backed phase, 14 Northern spring salamander, 3 young	State Game Lands
June 7, 1973 12:30-1:00 p.m.	Northern spring salamander, 1 Two-lined salamander, 1	State Game Lands
Oct. 12, 1973 2-4:30 p.m.	Slimy salamander, 1	near Heffner's Bridge

Oct. 16, 1973	Musk (stinkpot) turtle, 2 Muskrat, 4	State Game Lands

Questionnaire Results - 4 reports

Amphibians	Several, possibly Red eft stage of Red-spotted newt. Frogs and toads abundant.
Reptiles	Garter snake, 5 Black snake, 4
Mammals	Possums, skunks, raccoons, moles, shrews, bats listed in all four reports Common weasel, 7 - 1 report listed a family of 6 weasels Grey fox, 2 Red fox, 4 Fox, species unidentified, 3

Not too many residential dwellings are in this section, thus the numbers of reports for this area are few but seem to have been carefully documented.

Miscellaneous Questionnaires - 13 reports

We were unable to designate thirteen reports as to specific area but the information is of interest and is indicated below.

Amphibians	Red efts, 7 Pickerel frogs, 20
Reptiles	Garter snake, 19 Black snake, 5 Water snake, 4 Box turtle, 5 Snapping turtle, 3
Mammals	Possums, skunks, raccoons, common Grey fox, 2 Red fox, 4

Interviews with fur dealers also provided information about wildlife in the township but generally we could not be certain that all of the animals reported were actually trapped within the borders of Greenwich Township. The list below is compiled from information provided by Mr. Harry Adams of Edenburg.

Muskrat	ca 1,000 pelts
Possum	ca 800
Raccoon	150-200
Skunk	40-50

Grey fox	40-50
Red fox	40-50
Weasel	12
Mink	None in 1973, generally 1 or 2 yr.

Mr. Adams reported that more skunks were trapped this year (1974), foxes are being trapped in greater numbers since there is no bounty and no summer trapping to cause hunting pressure. Some animals such as weasels are probably abundant but are not trapped since there is not a demand for the pelts.

Mr. Sylvester Dietrich of Greenwich Township did not provide us with detailed data but indicated that the same relative abundance of animals as listed above was observed in the pelts he handled. He noted more red foxes this year, and a lot with mange disease. Possums are increasing in price and more are being trapped.

CHECKLIST OF AMPHIBIANS, REPTILES, AND MAMMALS OF GREENWICH TOWNSHIP

The following list of amphibians, reptiles, and mammals of Greenwich Township is based upon our field work, questionnaire data, information provided by fellow biologists, and published records from earlier wildlife surveys. Using this same data, we also attempted to provide an estimate of population levels of each listed species. Population levels are given according to the following criteria and symbols: (A) = abundant, animals readily seen, heard, or signs of their presence noted during their season of activity; (C) = common, those species with somewhat lower population levels, less frequently observed; (O) = occasional, animals which have restricted habitats and not readily observed; (R) = rare, animals noted by only a few observations over several years; (NE) = no estimate, present population levels of species listed from earlier published records due to lack of data were not estimated.

AMPHIBIANS

SCIENTIFIC NAME	COMMON NAME	POPULATION LEVEL
Scaphiopus holbrooki	Eastern Spadefoot Toad	(NE)
Bufo americanus	Common Toad	(A)
Bufo woodhousei	Woodhouse's Toad	(NE)
Hyla versicolor	Common Treefrog	(R)
Hyla crucifer	Spring Peeper	(A)
Acris crepitans	Northern Cricket Frog	(NE)
Pseudacris triserita	Western Chorus Frog	(NE)
Rana sylvatica	Wood Frog	(O)
Rana clamitans	Green Frog	(C)
Rana palustris	Pickerel Frog	(O)
Rana pipiens	Leopard Frog	(A)
Rana catesbeiana	Bullfrog	(A)
Notophthalmus viridescens	Red-spotted Newt	(C)
Ambystoma opacum	Marbled Salamander	(NE)
Ambystoma maculatum	Spotted Salamander	(R)
Desmognathus fuscus	Northern Dusky Salamander	(A)
Hemidactylium scutatum	Four-toes Salamander	(O)
Gryinophilus porphyriticus	Northern Spring Salamander	(C)
Pseudotriton ruber	Red Salamander	(O)
Eurycea bislineata	Two-lined Salamander	(C)

Amphibians (con't)

SCIENTIFIC NAME	COMMON NAME	POPULATION LEVEL
Eurycea longicauda	Long tailed Salamander	(NE)
Plethodon cinereus	Red-backed Salamander	(A)
Plethodon glutinosus	Slimy Salamander	(C)

REPTILES

SCIENTIFIC NAME	COMMON NAME	POPULATION LEVEL
Chelydra serpentina	Snapping Turtle	(C)
Kinosternon subrubrum	Mud Turtle	(O)
Sternothaerus odoratus	Musk (Stinkpot) Turtle	(O)
Terrapene carolina	Box Turtle	(C)
Clemmys guttata	Spotted Turtle	(O)
Clemmys muhlenbergi	Bog Turtle	(R)
Clemmys insculpta	Wood Turtle	(O)
Chrysemys picta	Painted Turtle	(O)
Pseudemys rubiventris	Red-bellied Turtle	(NE)
Eumeces fasciatus	Five-lined Skink	(R)
Sceloporus Undulatus	Eastern Fence Lizard	(R)
Crotalus horridus	Timber Rattlesnake	(R)
Agkistrodon contortrix	Cooperhead	(O)
Thamnophis sauritus	Ribbon Snake	(O)
Thamnophis sirtalis	Garter Snake	(A)
Lampropeltis triangulum	Milk Snake	(C)
Storeria occipitomaculata	Red-bellied Snake	(O)
Storeria dekayi	Brown (DeKay's) Snake	(O)
Carphophis amoenus	Worm Snake	(NE)
Heterodon platyrhinos	Eastern Hognose Snake	(O)
Natrix sipedon	Common Water Snake	(C)
Coluber constrictor	Racer	(O)
Elaphe obsoleta	Rat Snake	(O)
Diadophis punctatus	Eastern Ringneck Snake	(C)
Opheodrys vernalis	Smooth Green Snake	(O)

MAMMALS

SCIENTIFIC NAME	COMMON NAME	POPULATION LEVEL
Odocileus virginianus	White-tailed Deer	(C)
Ursus americanus	Black Bear	(R)
Sylvilagus floridanus	Cottontail Rabbit	(A)
Sciurus carolinensis	Grey Squirrel	(A)
Tamiasciurus hudsonicus	Red Squirrel	(O)
Marmota monax	Woodchuck	(A)
Procyon lotor	Raccoon	(A)
Didelphis virginiana	Oppossum	(A)
Castor canadensis	Beaver	(NE)

Mammals (con't)

SCIENTIFIC NAME	COMMON NAME	POPULATION LEVEL
Ondatra zibenthica	Muskrat	(A)
Mephitis mephitis	Skunk	(A)
Mustela vison	Mink	(O)
Mustela Frenata	Common Weasel	(O)
Vulpes fulva	Eastern Red Fox	(C)
Urocyon cinereoargenteus	Eastern Grey Fox	(C)
Scalopus aquaticus	Common Mole	(O)
Condylura cristata	Star-nosed Mole	(R)
Sorex dispar	Big-tailed Shrew	(NE)
Sorex fumeus	Smokey Shrew	(O)
Sorex cinereus	Masked Shrew	(NE)
Sorex palustris	Water Shrew	(NE)
Cryptotis parva	Little Short-tailed Shrew	(R)
Blarina brevicauda	Short-tailed Shrew	(O)
Eptesicus fuscus	Big Brown Bat	(O)
Lasiurus cinereus	Hoary Bat	(R)
Lasiurus borealis	Red Bat	(R)
Lasiurus seminolus	Seminole Bat	(NE)
Lasionycteris noctivagans	Silver-haired Bat	(NE)
Pipistrellus subflavus	Eastern Pipistrelle	(NE)
Myotis subulatus	Lieb's Bat	(NE)
Myotis sodalis	Social Bat	(NE)
Myotis kenni	Keen's Bat	(NE)
Myotis lucifugus	Little Brown Bat	(C)
Glaucomys volans	Eastern Flying Squirrel	(O)
Tamias striatus	Eastern Chipmunk	(C)
Peromyscus leucopus	White-footed Deer Mouse	(A)
Clethrionomys gapperi	Red-backed Vole	(O)
Microtus pebnsylvanicus	Meadow Vole	(A)
Pitymys pinetorum	Pine Mouse	(NE)
Mus musculus	House Mouse	(A)
Zapus hudsonicus	Meadow Jumping Mouse	(O)
Napeozapus insignis	Woodland Jumping Mouse	(O)
Rattus norvegicus	Norway Rat	(A)
Neotoma magister	Allegheny Wood Rat	(O)

FUTURE STUDIES

Our preliminary survey was done using the simplest of methods. We attempted to visit areas at various times of the day and seasons to locate wildlife of interest. We did not employ any trapping techniques since these methods would generally not be available to the non-specialist and we were trying to develop a procedure which could be utilized by the non-specialist. Also, trapping could have resulted in undesirable losses of wildlife which in some instances are already at low population levels.

Groups such as 4-H clubs, boy scouts, girl scouts, and other youth associations could contribute significantly in providing additional information about wildlife in the township. Each group could assume responsibility for a designated portion of the township. If systematic and frequent hikes were made through the area throughout the seasons, our knowledge about common and even more elusive species of amphibians, reptiles, and mammals would be enhanced. Perhaps a simplified identification manual of the animals most likely to be encountered in the township could be compiled. This manual ideally would have descriptions of tracks, calls, nests, or other signs to indicate the presence of animals even when the animal itself remains undetected. One of the public schools in the township or the biology department of Kutztown State could provide experts to serve as a center for the collection and interpretation of data supplied by the volunteer groups. Only with intensive and systematic observations over a period of years will a more complete wildlife survey be accomplished.

RECOMMENDATIONS

As indicated previously, our participation in the wildlife survey was not to compile a list of animals but to identify areas within the township worthy of preservation as habitats for animals, especially amphibians, reptiles, and non-game mammals. Obviously game species could also be present in such areas as well. Based upon our observations and from data from the other sources mentioned before, the following areas are listed in order of priority as places which should be zoned as conservation areas and be protected from pollution which might be harmful to the wildlife in these areas.

1. The flood plains along the Sacony Creek and Maiden Creek are ideal habitats for many types of wildlife and should be protected. The shallow ponds and swamps east of Lenhartsville especially should be maintained and carefully monitored to prevent pollution.

2. The northwest corner of the township along the Kittatiny Ridge is relatively unspoiled and uninhabitated. This region should be kept as free as possible of man's activities so as to retain the "Wild" nature.

3. The area around Camp Edmar would be worthy of preservation. This area in the central part of the township contains some relatively large tracts of trees of varying ages and would serve as a refuge for many kinds of animals.

4. Areas adjacent to State Game Lands No. 182, particularly those plots to the north and northeast of the game lands, should be carefully regulated. These areas are drainage areas into the game lands and water pollution in these areas would have adverse effects on the viability of the game lands.

5. Individual land owners should be encouraged to preserve hedge rows, line fences, thickets, swamps, etc. as wildlife refuges. Proper selection of trees and shrubs can be a great aid in attracting and maintaining wildlife.

REFERENCES

The only pertinent wildlife survey known to us were devoted solely to mammals.

Poole, E.L. 1932. A Survey of the Mammals of Berks County, Pennsylvania. Reading Public Museum and Art Gallery, Bulletin No. 13. A pioneering effort with much information of local interest even today.

Roberts, H.A. and R.C. Early, 1952. Mammal Survey of Southeastern Pennsylvania. Pennsylvania Game Commission, Harrisburg. A more recent, detailed study of this region of Pennsylvania with possibly two trap lines set within borders of the township.

The remaining sources were utilized for species identification and distribution.

Burt, W.H. and R.P. Grossenheider. 1952. A Field Guide to the Mammals. Houghton Mifflin Co., Boston.

Conant, R. 1958. A Field Guide to Reptiles and Amphibians of the United States and Canada East of the 100th Meridan. Houghton Mifflin Co., Boston.

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SOLID WASTE ANALYSIS

By

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Spring, 1974

ABSTRACT

Solid Waste Analysis

The Governor Minchot Group of the Sierra Club served as a study team in the Greenwich Township Environmental Analysis (GTEA) by investigating solid waste and its implications.

The questions posed by the study group were concerned with the solid waste disposal habits of the township residents. The main sources of information were gathered by personal interview, mail survey and on-site visitations.

Findings suggest that the residents were concerned with the physical appearance of their township. The overwhelming majority of the residents utilized commercial refuse collection and smaller percentages made use of commercial disposal as well as disposal on their own property. A limited amount of composting and recycling takes place.

The calculated amount of refuse disposed in a one week period averaged 1.89 twenty gallon cans per questionnaire respondents.

No definite pattern of solid waste disposal was evident by on-site visitations of open dumps within the township.

Although the majority of the open dumps appear to be inactive, two persistent problems seem to exist. One problem is the apparent dumping at the side of the road by passing vehicles and the second and more prominent is the large auto graveyard sites that remain active in the township.

The committee encourages the concept of recycling as a primary consideration for the residents of the township and land fill as a second but less desirous method.

Solid Waste Analysis

Background

The Governor Pinchot Group of the Sierra Club was approached by the Project Director in terms of the possibility of citizen input to the Greenwich Township Environmental Analysis (GTEA). After length discussions by the Sierra Club Board of Directors and the Project Director, a unanimous consensus was afforded in undertaking their part of the study.

The Sierra Club appointed their Conservation chairman as liaison person between them and the GTEA and also to serve as the coordinator of the study team. It was this person's responsibility to keep both the Sierra Club and GTEA appraised of the progress of the total study but in addition to expedite the facilitation of their section of the study as charged by the overall Project Director.

The study team coordinator worked closely with the Project Director at the initiation of the study due to the inexperience of this person with a study in the pure science realm. However, it should be noted that the main thrust of the direction given was not specifically in data collecting processes or scientific methodology. The idea began that this study team would represent the "non-expert" who might try and replicate a similar study in the future with only limited knowledge of scientific methodology. The principal investigator of this study team, Mr. Tom Schmoyer, was a Supervisor of County Special Education Classes and had some experience in data collection in the behavioral sciences.

Methodology

1. Main Question

The study was concerned with the solid waste disposal habits of the populace of Greenwich Township in order to recommend future action for that township.

2. Secondary Considerations

In the GTEA it was agreed that the following be taken into account for future reference as well as GTEA recommendations for consideration at the present time:

a. Site location. The study committee would attempt to pinpoint any visable solid waste disposal sites in the township. This was accomplished in a number of ways. Maps were used for reference and observation along with the actual driving of every passable road in the township.

b. Classification of solid waste. A concerted effort was made to classify the kinds of solid waste found at each township site by providing a written description of site content.

It was decided that an actual written description should be completed on each site.

c. Size. Where possible an actual measurement was taken of the site. When this was not feasible, due to location or size, an estimate was made.

d. Functioning. The survey team made an effort at each site to determine the activity or inactivity of dumping.

e. Removal cost. At the on-set of the survey the team tried to estimate the cost of land filling or removal. However, it was discovered that with the background of the participants as well as the constant changing cost of equipment, it was unrealistic to estimate such costs. It was decided, however, that additional experts could calculate estimated costs of removal.

f. Personal interviews. When feasible, the survey team conversed with individuals in the township to illicit information on sites and their location. In addition, the team interviewed individuals who were familiar with the area in terms of bottle collection. As it turned out, these people were as knowledgeable as the local residents or more so.

g. Mail survey. In cooperation with Kutztown State College a survey questionnaire was sent to 1,065 inhabitants of Greenwich Township. Of this number 109 responded for response percentage of about 10 percent.

Findings

1. Survey results. The solid waste disposal habits of the populace of Greenwich Township.

The overall statistics show the population in general is very much concerned with the appearance of their township as far as visible solid waste is concerned.

Approximately 82 percent of the people answering the mail questionnaire utilized a commercial refuse collection service that resulted in land-fill operations. In addition to this, 33 percent utilized their own land as disposal sites. However, included in this percentage is a representative number of individuals who recycled glass, cans, paper, composted waste, and then disposed the remainder on their property.

A small group (9 percent) utilized an "approved" site to dispose of solid waste. Again, these individuals were involved in recycling materials and the unrecyclable materials were those disposed of at the "approved site." The responses indicated that a "landfill in Schuylkill County" was being used.

Of the responses we find that 18 percent of the population used a combination of commercial collection, disposal on their own land, approved dump and/or recycling. This part of the questionnaire is definitely limited in that we had no way to calculate the percentage of the combination used. The problem could have been avoided by asking the respondents to check the actual combination used.

In relation to the survey it was found that the average amount of disposed solid waste over a one-week period was 1.89 twenty gallon cans per week per respondent. The highest amount of disposal per week was 7 twenty gallon cans and the low was 1/3 twenty gallon can per week.

Of the 109 responding it was determined that a limited amount of recycling was taking place. The receiving sites were: the Coca-Cola plant in Hamburg for glass; the Kutztown Fire Company for paper and glass; "Collection Center in Hamburg" for tin cans.

Along the same lines 6 percent of the people responding utilized composting; 0.9 percent fed "edible garbage" to farm animals; 3 percent burned their paper; 10 percent "plowed under" any decayable garbage; and 0.9 percent had "too little" garbage to comment.

2. On-site locations.

It was determined, after driving every road passable in Greenwich Township that there is no definite pattern for solid waste disposal. Solid waste had been discarded in every section of the township and sites vary from a few square feet to hundred of square feet.

An encouraging fact is that the majority of sites are inactive. That is, the materials in the sites are not new dumpings. It was found that about 90 percent of the actual dumps examined were not in use.

Of those inactive sites, the actual composition of the solid waste was comprised of cans; glass; construction (or destruction) materials, e.g. bricks, lathe, lumber; home appliance disposal, e.g. refrigerators, stoves, televisions; automobiles, farm equipment and the like; as well as other items.

The active sites had limited amounts of the above material, and were mainly composed of the "weekly household garbage." These active sites were found along the side of the roads and waste appeared to be discharged from passing vehicles.

It would be impossible with the time and team members involved to actually be knowledgeable of, let alone visit, every active or inactive open site in the township. Apparently in the past a great majority of land owners utilized a section of their own land as a dump site for their famil refuse; however, a high percentage of the open dumps are not inactive.

The study team observed one specific open dump that requires mention. At the junction of T777 and LR 06134 where two small streams junction on Wessner Road, there exists what appears to be an auto graveyard that encompasses acres of land. Also included in this site are abandoned appliances, trailers, building materials, bed springs, etc.

Other similar areas exist at the junction of LR06044 and 737 on the east and west sides of the roads as well as LR06135 at Dunkel's Church; T777 Wessner Road at the origin of a small stream approximately 3/4 mile north of LR06134 and T795 approximately 3/4 miles north of T775.

POPULATION STUDY

by

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September, 1974

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ABSTRACT

Population Study

To help in interpreting what the future may hold for Greenwich Township, a survey was sent to the households and results analyzed. The results of the survey were analyzed using the maximum number of children that lived in the household between 1960-1973 as the analysis base. A fee for the population movement into and out of the township was one goal.

The first part of the report included general knowledge concerning the makeup of the residents. These include age range of head of the household and spouse and the average age, age range of children and average age separated by sex, average age of the population by sex, the average number of children per household, relation to head and marital status. Also included were education level, occupation, color, and nationality, birthplace and migration, the year moved in and out of the township and the range. These factors were analyzed by sex.

All above data were expressed as percentages. Questions such as where born, when moved out, why, plans to stay, and why to you want to live here, gave trends and attitudes.

The second part of the report deals with various information that could influence the environment of the township. These are: type of living quarters, when built (range), how heated, source of water, method of sewage disposal, method of trash disposal, number of autos. Averages were calculated. The results were represented by percentages. The results were analyzed by size of household.

Part two also analyzed the land belonging to the household: amount of land (acreage), type of land, and use of land. Percentages were used. The range and average per household was calculated.

Comments and expansion by the household was encouraged. These showed some values, attitudes and trends that exist in a cross section of the township.

Supplemental township data from various sources to compare them with some trends are found in the report. Some of these data include: land area, population, population density, changes, housing units, mileage of roads. These were compared with other areas and the county as a whole. Population projections for the future were included.

The analysis can be best used to observe trends and important attitudes. Haphazard development of the township was the major concern of the residents. They want controlled, intelligent, planned, development for the future.

Recommendations for future reports was included at the end of the analysis.

Population Study

Purpose

The purpose of the population study segment of the Environmental Analysis of Greenwich Township is to aid us in interpreting what the future may hold for the township based on past and present trends.

Methodology

A survey questionnaire and instructional help sheet were sent to each household in Greenwich Township and the Borough of Lenhartsville. A copy of each of these is included in this report.

The resident was urged to take an interest in the analysis by filling out the population study form and returning it to us before January 30, 1974 at KSC.

We then compiled the results of the returns and tried to draw some general conclusions about the make-up of the population. The results are what will be presented in this report. Reasons why some of these results should be used with caution will be expanded upon later in this report.

I have chosen to present the results of the report using the maximum number of children that lived in the household between 1960-1973 as our analysis base.

Findings

Important

I am presenting the findings and results of the poll using the maximum number of children living in the household between 1960-1973 as our variable.

The head of the household was asked to list all the persons who ever lived in the household between the years 1960-1973. We asked them to list the name of each person who lived there between these years. We asked them to include the last name of the family also.

Included in the list was how each person was related to the head of the household (son, daughter, mother, wife, etc.).

Included in the list was the sex (M or F), age (now), marital status now (single, married, divorced, separated, widow, etc.), number of children (now). If they no longer lived there in the household today, we asked the head to let us know why. We would like to know why so that we could pinpoint some reasons why emigration from the township occurred.

Included in the list was the education (grade, high school, college, etc.), occupation (as specific as possible), race or color (white, black, etc.), nationality (Pa. Dutch, German, Italian, etc.).

Included in the list were the following questions in order to get a feel for population movement into and out of the township:

1. Where born (township and county)? They were asked to be specific.
2. When moved into Greenwich (the year)? If they were born here they were instructed to leave it blank.
3. When moved out of Greenwich (the year)? If they still lived here they were instructed to leave it blank.
4. Do you plan to stay in Greenwich (yes or no)?
5. Why do you want to live here in Greenwich? They were asked to be specific.

It was important that they used the instruction sheet as a guide along with the analysis sheet.

These results comprise the first part of the body of this report. This includes general knowledge concerning the makeup of the residents.

It is again important to note that we are using the maximum number of children in the household between 1960-1973 as our variable.

Analysis of Charts 1 through 6

In order to interpret the results on the charts, a brief description of the set-up of the charts is in order.

The first column (far left) will list the various characteristics of the population.

In the remaining columns, the "M" represents male, the "F" represents female.

Columns 2 through 15 are represented with the sex (as explained above) and a number. The number represents the number (maximum) of children living in the household between 1960-1973. The range is from marriages with no children to marriages with 6 and over children. The numbers at the top of the columns range from 0 to 6 and over.

Columns 16 and 17 are represented with the sex and an "Si". This represents single people. In these columns can be seen "see page on singles." This will be explained later in the report. No data is given in these two columns.

Columns 18 and 19 are represented with the sex and the total for each sex.

Column 20 is represented by the grand total with male and female combined.

From the name of each person as described before, relation to head, sex, marital status and number of children; we obtained the following results.

Table 13. Chart 1 - Age of the Head of Household and the Spouse, if Any (numbers are expressed as percentages).

Age Range	M-0	F-0	M-1	F-1	M-2	F-2	M-3	F-3	M-4	F-4	M-5	F-5	M-6 & Over	F-6 & Over	M-Si	F-Si	M-Total	F-Total	M&F-Total
80-89	8.7	4.3	5.9	5.9											See Page on Singles	See Page on Singles	2.9	1.9	2.4
75-79		13.0																2.9	1.4
70-74		8.7			4.3												1.0	1.9	1.4
65-69	26.1	17.4	5.9			8.7	5.6						25.0				8.6	5.7	7.1
60-64	8.7	17.4			4.3												2.9	4.8	3.8
55-59	21.7	8.7	23.5	17.6	4.3	4.3	5.6	11.1						25.0			10.5	8.6	9.5
50-54	4.3	4.3		11.8	4.3	4.3	5.6	5.6	9.1		16.7	16.7	25.0	25.0			5.7	6.7	6.2
45-49	8.7	4.3	17.6	11.8	21.7	8.7	16.7	11.1	54.5	27.3	33.3	16.7	50.0	50.0			22.9	12.4	17.6
40-44	4.3			5.9	13.0	17.4	11.1	16.7	9.1	27.3	33.3	16.7					9.5	11.4	10.5
35-39					4.3	13.0	22.2	22.2	27.3	27.3	16.7	16.7					8.6	10.5	9.5
30-34		4.3	11.8		13.0	8.7	11.1	27.8		9.1		33.3					6.7	10.5	8.6
25-29		8.7	5.9	23.5	17.4	21.7		5.6									4.8	11.4	8.1
20-24	8.7	8.7	23.5	11.8	8.7	8.7											7.6	7.6	7.6
15-19	4.3			5.9													1.9	1.0	1.4
Deceased	4.3		5.9	5.9	4.3	4.3	22.2			9.1							6.7	2.9	4.8
Average	55.7	56.5	44.6	41.2	40.2	39.0	43.9	40.4	44.5	40.7	44.0	41.0	54.0	51.0			46.0	44.1	45.1

Table 14. Chart 2 - Age of Children (numbers in percent)

Age Range	M-O	F-O	M-1	F-1	M-2	F-2	M-3	F-3	M-4	F-4	M-5	F-5	M-6 & Over	F-6 & Over	M-Si	F-Si	M-Total	F-Total	M&F-Total
35-39	Not Applicable	Not Applicable		22.2												See Page on Singles		2.0	1.0
30-34					9.5		3.7	7.1									3.0	2.0	2.5
25-29			33.3		14.3	4.3	11.1	10.7				7.7	16.7	14.3			9.9	6.1	8.0
20-24			16.7	22.2	14.3	17.4	11.1	10.7	33.3	16.7	17.6	23.1	33.3	42.9			19.8	18.4	19.1
15-19			16.7	11.1	23.8	4.3	14.8	10.7	44.4	33.3	11.8	15.4	33.3	28.6			23.8	15.3	19.6
10-14					14.3	13.0	22.2	14.3	16.7	38.9	29.4	38.5	16.7				18.8	19.4	19.1
5-9			16.7	11.1	14.3	34.8	25.9	32.1	5.6	5.6	29.4	15.4		14.3			16.8	22.4	19.6
0-4			16.7	33.3	9.5	26.1	11.1	14.3		5.6	11.8						7.9	14.3	11.1
Deceased																			
Average			17.3	16.4	17.2	10.3	13.9	13.8	17.1	15.3	11.1	15.4	18.8	19.3			15.6	14.1	14.9

In developing the results of Charts 1 and 2 we were dealing with the following data:

Number of Children	Number of Married Households
0	23
1	17
2	23
3	18
4	11
5	6
6	2
7	1
11	1

There were 4 households with 6 and over children, and 6 households with 5 children. These numbers may not be high enough to prevent skewing of the data.

There were 3 male single households and 3 female single households. Again these are not of sufficient numbers to present valid data.

It can be seen that there were 102 married households (79 of these had children and 23 did not). This gives a total of 108 households when we include the singles. Therefore, in the data, there were 105 males and 105 females. These are included in Chart 1. Total 210.

In Chart 2 there was a total of 221 children. These included 112 males and 109 females.

The average male age for the population was 31.1. The average female age for the population was 29.6. This gave a total average male and female age for the population of 30.4.

If we use the 221 total children and 108 total households, we get 2.1 as the average number of children per household.

If we use 102 total married households, we get an average of 2.2.

If we use 79 total married households with children, we get 2.8 as the average number.

The questionnaire also found that a number of households had children but the children left before 1960 and no longer lived in the household.

Number of Children	Number of Married Households
1	14
2	3
3	2
4	2
6	1
9	1

We have here 23 households and 49 children. If we use this date we have a total of 270 children, 131 total households, 125 total married households and 102 total married households with children. The average number of children is 2.1, 2.2, 2.7 respectively. This is practically no different from results without these households.

From these total numbers, analysis of data can be used with numbers rather than percentages if this is desirable.

From the education, occupation, race or color, nationality; we obtained the following results.

Table 15. Chart 3 - Education of Head of Household and Spouse, if Any
(numbers in percent)

Education Level	M-0	F-0	M-1	F-1	M-2	F-2	M-3	F-3	M-4	F-4	M-5	F-5	M-6 & Over	F-6 & Over	M-Si	F-Si	M-Total	F-Total	M&F-Tota
Grade	42.1	45.0	35.7	40.0	23.8	9.1	23.5	22.2	18.2	20.0	33.3	33.3	75.0	25.0	See Page on Singles	See Page on Singles	32.2	26.8	29.5
High	31.6	35.0	42.9	60.0	61.9	86.4	23.5	33.3	45.5	50.0	33.3	16.7	25.0	75.0			39.8	51.5	45.8
College	21.1	15.0	14.3		14.3	4.5	29.4	38.9	27.3	20.0		33.3					18.3	16.5	17.4
Higher	5.3	5.0	7.1				23.5	5.6	9.1	10.0	33.3	16.7					9.7	5.2	7.4

Table 16. Chart 4 - Occupation of Head of Household and Spouse, if Any
(numbers in percent)

Occupation	M-0	F-0	M-1	F-1	M-2	F-2	M-3	F-3	M-4	F-4	M-5	F-5	M-6 & Over	F-6 & Over	M-Si	F-Si	M-Total	F-Total	M&F-Tota
Professional-Technical	25.0	11.1	7.1	6.7	8.7	9.5	41.2	10.5	33.3	7.7	33.3				See Page on Singles	See Page on Singles	21.8	8.9	15.3
Managers, Officials, Proprietors	25.0		28.6				11.8	5.3	8.3								10.3	2.2	6.2
Farm	12.5		21.4		21.7		17.6		16.7		16.7		16.7				18.4		9.0
Clerical		11.1			4.3	14.3		10.5						20.0			1.1	7.8	4.5
Sales				6.7	4.3				8.3			20.0					2.3	2.2	2.3
Craftsmen, Foremen	12.5				21.7	4.8	11.8		16.7		16.7		16.7				13.8	1.1	7.3
Service Workers Households						4.8		5.3	8.3				16.7				2.3	2.2	2.3
Laborers	12.5	22.2	28.6		21.7	19.0	5.9	10.5	8.3	15.4	16.7		16.7				16.1	12.2	14.1
Operatives				6.7	8.7	4.8	5.9				16.7						4.6	2.2	3.4
Housewife		44.4		80.0		38.1		57.9		76.9		80.0		80.0				58.9	29.9
Retired	12.5	11.1	14.3		8.7	4.8	5.9						33.3				9.2	2.2	5.6

Table 17. Chart 5 - Nationality of Head of Household and Spouse, if Any
(numbers in percent)

Nationality	M-0	F-0	M-1	F-1	M-2	F-2	M-3	F-3	M-4	F-4	M-5	F-5	M-6 & Over	F-6 & Over	M-Si	F-Si	M-Total	F-Total	M&F-Tota
Pa. Dutch	75.0	87.5	81.8	60.0	85.0	94.7	53.3	47.4	55.6	71.4	33.3	33.3	80.0	66.7	See Page on Singles	See Page on Singles	69.4	67.1	68.2
German	25.0	12.5	9.1	20.0	5.0	5.3	26.7	15.8			33.3	11.1	20.0				13.9	11.1	12.3
English				13.3	5.0		13.3	10.5	22.2	14.3		22.2					6.9	8.5	7.8
Ukranian					5.0						16.7						2.8		1.3
Irish								5.3		14.3	16.7	11.1		33.3			1.4	4.9	3.2
Slovak							6.7	5.3									1.4	1.2	1.3
Hungarian			9.1									11.1					1.4	1.2	1.3
Swedish									11.1								1.4		0.60
Polish								5.3				11.1						2.4	1.3
French								5.3										1.2	0.60
Scotch								5.3	11.1								1.4	1.2	1.3
Swiss				6.7														1.2	0.60
Race or Color	100% White																		

On Chart 6 the first part represents whether they were or were not born in Greenwich Township. The numbers in these columns are expressed as percentages.

The second part represents when they moved into the township if they were not born here. Percentages are used.

The third part represents the range of migration into the township using specific years.

Table 18. Chart 6 - Birthplace and Migration of Head of Household and Spouse, if Any
(numbers in percent)

Birthplace and Migration	M-0	F-0	M-1	F-1	M-2	F-2	M-3	F-3	M-4	F-4	M-5	F-5	M-6 & Over	F-6 & Over	M-Si	F-Si	M-Total	F-Total	M&F-Total
Yes	15.8	18.2	33.3	21.4	38.1	22.7	20.0	18.8	30.0		16.7		60.0	20.0	See Page on Singles	See Page on Singles	29.3	16.7	22.9
No	84.2	81.8	66.7	78.6	61.9	77.3	80.0	81.3	70.0	100.0	83.3	100.0	40.0	80.0			70.7	83.3	77.1
1900-1919				50.0	7.7												1.5	7.7	2.6
1920-1929																			
1930-1939	6.3						8.3		14.3								4.6		3.8
1940-1949	18.8		30.0		15.4		16.7										15.4		12.8
1950-1959		33.3			15.4	50.0			42.9				100.0				10.8	15.4	11.5
1960-1969	43.8	66.7	30.0	50.0	46.2	50.0	66.7	100.0	14.3	100.0	80.0	100.0		100.0			44.6	61.5	47.4
1970-Present	31.3		40.0		15.4		8.3		28.6		20.0						23.1	15.4	21.8
Range	1930 1972	1951 1969	1946 1971	1916 1960	1901 1972	1959 1966	1938 1970	1960 1969	1933 1971	1960 1969	1960 1971	1960 1969	1952 1953	1960 1969			1901 1972	1916 1973	1901 1973

The question, "where born," gave a very wide variety of responses. These ranged from adjoining townships to other countries. No data was collected on exact locations because of the wide variety. A significant number were forn in adjacent townships (Albany, etc.) and adjacent counties (Lehigh, etc.).

The question, "when moved out," helped us to interpret data that can be found on previous charts and also in responses to other questions as will be seen later in the report. No data range was recorded as was done with "when moved in." It must be remembered that these questions also helped us in our analysis of some of the previous charts.

The questions, "plans to stay" and "why do you want to live here," brought about these results:

80.4% of the household heads plan to stay in the township. 15.4% plan not to say, and 4.2% undecided. A significant percent of the teen and above children had no intention of staying here. This will be expanded upon later.

I did not collect percentage data on the reasons why they want to live here. The report will include a list of responses that were fed-back to us. The responses appear in the order that they appeared most often to least often with approximate percentages

No Children and Singles.

57.1% Beautiful countryside, country atmosphere, country living, love country, beautiful area, fresh and clean air, nice and good place to live, scenery, trees, clean, few crimes, safe, good environment, not crowded, isolation, low population density, unspoiled by industry, climate.

42.9% Home, farm, lived here all life, like it, friends, people, live near children if disabled or can't drive, friendly neighbors, got married, work or job, religion, moderate taxes.

One Child.

60.0% Country life, rural, away from city, ideal conditions, peace and quiet, best place to live, beautiful area, country setting, good place for children.

40.0% Live here all life, job, home, close to work, like it.

Two Children.

41.9% Rural, country, green and peaceful, scenery, clean air, lacks industry, hunting.

58.1% Anchored to farm, home here, like it, born and raised, heritage ties, ancestors here, friends, good people, history, antiques, philosophy.

Three Children.

64.3% Country living, country setting, rural, clean, low crime rate, isn't crowded, relatively undeveloped, peaceful, quiet, wildlife, like to be left alone, privacy.

35.7% Home, work, close to town, property here, like it, born here, farm, love it.

Four Children.

64.0% Nice rural area, country living, beautiful environment, found no better place, countryside, good climate, peaceful, unspolied, like location, solitude, very liveable, great place to raise children.

36.0% Work, born here, peole, friends, home, like it.

Five, Six, Seven, Eleven Children.

54.2% Beautiful area, rural, open country, peaceful and quiet, not crowded, healthy for children, clean air, rural enough to own acreage, prefer trees to asphalt, out of town, nice place to live.

45.8% Born here, dairy area, like it, neighbors, close to metropolitan areas for business, work, schools business, home here, originally from here.

The second part of the report deals with various information that could influence the environment of the township. The information needed to determine these factors are as follows.

The head was asked to give the type of living quarters (private home, apartment, etc.) and when it was built. An approximate year was all that was asked.

Other questions were: how the household is heated (oil, gas, coal, electric, etc.), the source of water (municipal, well, etc.), method of sewage disposal (cesspool, septic tank, municipal, etc.), and the number of autos (the number now) in the household.

The last set of questions inquired about the land belonging to the household. Asked was: the amount of land (acreage or frontage), the type of land (wooded, meadow, etc.), and the use of the land (farm, recreation, etc.).

They were told that any other comments can be made on the back of the survey. If there was anything they would like to expand on, they then used the reverse side.

These results comprise the second part of the body of this report.

Analysis of Charts 7 thru 16

In order to interpret the results of the charts, a brief explanation of the set-up of the charts is in order.

The first column (far left) will list the various characteristics of the household.

Columns 2 through 8 are represented with a number. The number represents the number (maximum) of children living in the household between 1960-1973. The range is from marriages with no children to marriages with 6 and over children. The numbers at the top of the columns range from 0 to 6 and over.

Column 9 is represented with an "Si". This represents single people. In this column can be seen "see page on singles." This will be explained later in the report. No data is given in this column.

Column 10 is represented by the grand total.

From the type of living quarters, when built, how heated, source of water, method of sewage disposal, method of trash disposal, number of autos, we obtained the following results.

Table 19. Chart 7 - Living Quarters Type
(numbers in percent)

Type Living Quarters	0	1	2	3	4	5	6 & Over	Si	Total
Private Home (including farmhouses)	88.9	94.4	100.0	88.9	100.0	85.7	75.0	See Page on Singles	92.2
Mobile Home	7.4	5.6				14.3			3.9
Two-Family Home				11.1					1.9
Apartment	3.7						25.0		1.9

Table 20. Chart 8 - When Living Quarters Were Built
(numbers in percent)

When Living Quarters Built	0	1	2	3	4	5	6 & Over	Si	Total
Before 1800		7.1			9.1	14.3		See Page on Singles	3.4
1800 - 1850	22.7	14.3		20.0	36.4	14.3			18.0
1851 - 1899	9.1	35.7	20.0	13.3	18.2	14.3	75.0		20.2
1900 - 1949	18.2	14.3	20.0		18.2	14.3	25.0		14.6
1950 - 1959	9.1	7.1	6.7	6.7	18.2	14.3			9.0
1960 - 1973	41.0	21.4	53.3	60.0		28.6			34.8
Ranges	1800 1973	1790 1973	1858 1972	1800 1971	1763 1957	1790 1971	1870 1928		1763-1973

Table 21. Chart 9 - How Household is Heated
(numbers in percent)

How Heated	0	1	2	3	4	5	6 & Over	Si	Total
Electricity	13.8	23.5	17.6	15.8		16.7		See Page on Singles	14.2
Coal	13.8	11.8	17.6	5.3			50.0		12.3
Oil	65.5	58.8	64.7	73.7	100.0	83.3	33.3		68.9
Kerosene		5.9							0.90
Fireplace				5.3					0.90
Wood Stove	6.9						16.7		2.8

Table 22. Chart 10 - Source of Water
(numbers in percent)

Source of Water	0	1	2	3	4	5	6 & Over	Si	Total
Well	96.0	78.9	100.0	94.4	72.7	83.3	66.7	See Page on Singles	88.0
Spring	4.0	21.1		5.6	27.3	16.7	33.3		12.0

Table 23. Chart 11 - Sewage Disposal
(numbers in percent)

Method of Sewage Disposal	0	1	2	3	4	5	6 & Over	Si	Total
Septic	79.2	94.1	84.2	90.0	100.0	83.3	50.0	See Page on Singles	86.3
Cesspool	12.5	5.9	10.5	10.0		16.7	25.0		9.8
Outhouse	8.3		5.3				25.0		3.9

Table 24. Chart 12 - Trash Disposal
(numbers in percent)

Method of Trash Disposal	0	1	2	3	4	5	6 & Over	Si	Total
Collection	55.2	44.4	40.0	57.9	53.3	28.6		See Page on Singles	47.0
Self	17.2	33.3	18.2	21.1	6.7	28.6			19.1
Landfill		16.7	13.6	5.3	6.7				7.0
Compost		5.6							.90
Burn	20.7		18.2	15.8	33.3	42.9	75.0		20.9
Bury	3.4		9.1				25.0		4.3
Recycle	3.4								.90

Table 25. Chart 13 - Number of Autos
(numbers in percent)

Number of Autos	0	1	2	3	4	5	6 & Over	Si	Total
0	4.2	11.8						See Page on Singles	3.1
1	62.5	29.4	41.2	22.2					32.7
2	25.0	47.1	41.2	61.1	36.4	66.7	25.0		41.8
3	8.3	11.8	11.8	11.1	54.5		75.0		17.3
4				5.6		16.7			2.0
5					9.1				1.0
6						16.7			1.0
7			5.9						1.0
Average	1.4	1.6	2.0	2.0	2.8	3.0	2.8		1.9

Table 26. Chart 14 - Amount of Land Per Household
(numbers in percent)

Amount of Land (acres)	0	1	2	3	4	5	6 & Over	Si	Total
Less Than 1 Acre	9.5	7.1	5.9	10.5	18.2	16.7		See Page on Singles	9.7
1 - 10 Acres	57.1	35.7	52.9	47.4	36.4	16.7	25.0		44.1
11 - 50 Acres	9.5	28.6	17.6	10.5		50.0	50.0		17.2
51 - 100 Acres	9.5	14.3	17.6	5.3	18.2		25.0		11.8
101 - 200 Acres	14.3	14.3	5.9	26.3	27.3				16.1
201 - 300 Acres									
301 - 400 Acres						16.7			1.1
Range	1/4-175	1/2-173	3/4-165	1/4-180	1/4-170	1/4-350	5-83		1/4-350
Average Acres	31.63	46.44	29.40	73.43	58.46	73.29	36.0		50.16

Table 27. Chart 15 - Type of Land
(numbers in percent)

Type of Land	0	1	2	3	4	5	6 & Over	Si	Total
Wooded	30.8	36.8	38.1	47.4	26.7	25.0	14.3	See Page on Singles	33.6
Lawn, Lot, Mixture, Recreation	26.9	5.3	19.0	5.3	20.0	37.5	14.3		17.2
Farm, Meadow, Field, (including rocky shale)	42.3	52.6	38.1	42.1	53.3	37.5	28.6		44.0
Hills		5.3	4.8	5.3			42.9		5.2

Table 28. Chart 16 - Use of Land
(numbers in percent)

Use of Land	0	1	2	3	4	5	6 & Over	Si	Total
Living, Recreation, Grass, (including mobile home lot)	27.6	23.1	47.4	33.3	42.9	50.0	20.0	See Page on Singles	34.3
Farm, Meadow, Pasture, (including horse use) and (including farm rentals)	34.5	61.5	26.3	28.6	42.9	33.3	60.0		38.0
Garden	13.8	15.4	21.1	9.5	7.1	16.7	20.0		13.9
Wooded, swamp, forest, rolling hills, open (birds and wildlife included)	24.1		5.3	28.6	7.1				13.9

Singles Data and Results

There were only 3 male single households and 3 female single households that responded. These are not of sufficient numbers to present valid data. Therefore, I am including the singles data on this page. However, the data for singles is reflected in the totals on previous charts.

Chart 1.

M 45-49 (33.3)	F 60-64 (33.3)
40-44 (33.3)	20-24 (66.7)
15-19 (33.3)	average (36.0
average (35.7)	

Chart 2.

M None	F None

Chart 3.

M Grade (100.0)	F College (50.0)
	Higher (50.0)

Chart 4.

M Professional-(100.0) Technical	F Professional-Technical (33.3)
	Managers, Officials, Proprietors (33.3)
	Laborers (33.3)

Chart 5.

M Pa. Dutch (100.0)	F Pa. Dutch (100.0)

Chart 6.

M Yes (100.0)	F No (100.0)
	1970-Present (100.0)
	Range 1970-1973

Chart 7.

Private Home (including Farmhouses) (100.0)

Chart 8.

1800-1850 (100.0)

Range 1810-

Chart 9.

Oil (100.0)

Chart 10.

Spring (100.0)

Chart 11.

Septic (100.0)

Chart 12.

Bury (100.0)

Chart 13.

1 - (100.0)

Average 1.0

Chart 14.

101-200 (100.0)

Range - 200 -

Average 200

Chart 15.

Farm, Meadow, Field (including rocky shale) (100.0)

Chart 16.

Farm, meadow, pasture (including horse use) and (including farm rentals) (100.0)

Results of Comments

This report also contains the various comments and expansions that were entered on the questionnaire. The value may be a feeling for some trends and attitudes that exist in a cross section of the township. I feel some of these trends and attitudes are important enough to include here.

One Child - some of these households had in-laws living with them now and in the past. Mostly a temporary situation. The in-laws moved out within a few years usually. Some said that the only thing that keeps them here is their job. Some of the sons moved out after they got married. A large number of daughters don't know if they will stay in the township. They will also probably move out when they get married. The girls that did move did so for this reason.

Two Children -

Here also we have a significant number of in-laws living in the household (up to 3 in number). Again it is a temporary situation in most cases.

Also the children are usually undecided if they will stay. The daughters that moved out did so because they got married. A few of the sons also moved out when they got married. Even though a number of the children are undecided if they will stay, a significant number do not intend to stay in the township. The trend seems to be that the girls in the family are the ones that do not intend to stay as compred to the boys.

A significant number of people want the township to stay the way it is now. They do not want an inundation of "trailers" and junk in the township.

Three Children -

Again the children are usually undecided if they will stay. The daughters usually will not stay. The girls that moved out did so when they got married. A very large number of girls moved out for this reason. Also we see some of the sons moving when they got married. Some of the sons moved out because of the job he obtained.

Here we noted the head of household was deceased in a large number of the households. This was noted also by the spouse. We see in-laws living in the household in a large percentage of the households.

Again we see concern over trailers. Some felt that there were too many trailers now and they want "no terrible house trailers." Some felt they put a burden on the school system because they generate very little tax money which makes higher taxes for the homeowner.

Some fear for future development of the township. They feel that haphazard development is encouraged by leaders in the township and country government. They want the county planning commission to make an effort for controlled and planned development. Incompetent planning should be a thing of the past. They were glad that our group has taken an active concern.

Four Children -

Here we see the trend that the sons do not intend to stay. The sons that moved out did so when they got married. Daughters also left when they got married. Some of the children do not know if they will stay. We also see in-laws living in the households (sons and daughters and their children). Again it is temporary.

Some felt there should be a supervisor for the farmers in the township government. Some felt there should be more police protection.

A significant number were concerned with housing construction and concern that the township will be kept clean. Some felt that the township should be cleaned up more efficiently.

One resident mentioned that the township meetings decide the future of the township without the expression of the resident. The township supervisors' meeting average 2-8 residents showing an apathy of the residents toward local government.

Again we see a few glad that we are doing this survey.

A significant number want the township to be maintained as it is.

They are concerned with new construction and want no industrialization.

Five, Six and Over Children -

We see in these households, again, the trend for the daughters to move out when they get married. The girls stated that they will stay until they get married. A large number of daughters have already moved out for this reason. This was the case in the 4, 5, and 6 and over households. A large number of children do not know if they want to stay in the township. This attitude is significant here in all size households. It exists especially with the sons. We see some sons moving from the township because of marriage. A few of the sons do not intend to say under any circumstances.

We also see in-laws in the household (daughter-in-laws and son-in-laws and children). Again, it is temporary but is prevalent. The in-laws are found in all size households. Some of the in-laws have become deceased while living in the household.

No Children and Singles -

These households did not have much to say. Some of the heads were deceased. Children moved out when they got married. This was before 1960. Some in-laws living in these households.

Some felt that taxes are too high for so few people in the household.

We obtained most of the comments and expansions from the questions on how they were related to the head of the household. Also when we asked when the individuals moved out, this gave us a lot of data to work with. We told the head that we would like to know why they moved out and what the intentions were for the future. This also gave us additional information. Some of the in-laws were included in the data. Most were not because of the temporary situation that they indicated existed. Lehigh County, Albany Township and the surrounding areas serve as an emigration and immigration place for the households of Greenwich Township.

Supplemental Township Data

Some data from the Census Bureau and Department of Environmental Resources is being included in this report. These projections for the future can be compared with some of the trends we found in this report.

	Lenhartsville	Greenwich Township
Land Area (square miles)	0.1	30.8
Population 1970 (Final)	220	1404
Population (1960)	209	1257
Numerical Change	+11	+147
Percent Change	5.3	11.7
Population Density per Square Mile (1970)	2200	45.6
Population Density per Square Mile (1960)	2090	40.8
Housing Units (1970)	72	458
Housing Units (1960)	71	406
Local Roads (as of 1/1/70)	.35	81.87
State Roads (as of 1965)	.81	33.21
Total Roads	1.16	115.08

The population density per square mile for the boroughs of Berks County went from 2684.8 to 2971.0 (1960-1970), the townships of Berks went from 134.1 to 163.6 (1960-1970), the total county went from 318.6 to 342.6 (1960-1970).

The overall percent change in the population of Berks County from 1960-1970 was 7.6%.

The population density per square mile in 1970 for the townships that have a less density than Greenwich are as follows:

Albany	27.4
North Heidelberg	50.2
Upper Tulpehocken	34.3

Greenwich Township has more Public Road Mileage than any other township in Berks County.

Projections-Population

	Lenhartsville		Greenwich Township	
	Bureau of Census	State Dept. of Environmental Resources (June, 1972)	Bureau of Census	State Dept. of Environmental Resources (June, 1972)
1970	220	220	1404	1404
1980	262	244	1549	1720
1990	320	262	1698	1956
2000	352	299	1851	2282
2010	402	332	2092	2595
2020	---	371	----	2986

Procedures

A special note of caution should be used in drawing concrete conclusions from this report. This is one of the reasons that I am reluctant in drawing too many of these in my analysis.

We sent out form to 530 households and had a return of 130 forms. This represents 24.5% of the households. Only 108 of these could be used because of incompleteness, duplication, etc. This then represents 20.4% of the households. 4.1% were unuseable.

This may skew the results in one direction or another. It can be assumed that we have a cross section, of the general population, but there is no guarantee of this.

Conclusions

I am reluctant to draw conclusions. The reasons for this was expanded upon earlier in the report. Instead, this analysis can best be used to observe trends and some important attitudes. These were mentioned earlier.

The people as a whole were glad we were doing this analysis. One elderly man, who lived by himself, could hardly write, but he did his best to fill out the report. We had a few who did not take it seriously.

One main attitude that arose from this analysis is the concern over haphazard development of the township. One need only look at the reasons why people want to live in the township to draw conclusions as to the future, keeping in mind the citizens' attitudes and values. This is probably the most significant outcome of my findings. Here we see an expression of feelings from within the individual.

Many other trends and attitudes can be observed from the analysis.

Recommendations

Methods which could be used by non-experts is important to note here The same general procedure could be used by others in a survey of this type. But, I feel a door to door personal interview would be better if you have the time and manpower.

A more detailed study could be carried on by the census bureau and Berks County Planning Commission or the State Department of Environmental Resources. Tax census data could be used and correlated with interview findings.

The conclusions drawn from this type of study would, of course, be more valid.

Our report is to serve as a stepping-stone for, hopefully, a more complete and detailed report in the future. It is only through reports of the above type that we will have controlled, intelligent, planned development (or undevelopment) of our disappearing open spaces.

SUMMARY

by

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SUMMARY

Has anything been accomplished by the efforts of the Greenwich Township Environmental Analysis (GTEA) project? Answers to this question can be quite simple, ranging from, "Nothing has been concluded," to "Tremendous potential for action has been generated." If one thinks in terms of causing a direct change or action on the part of township authorities and residents, then the first answer, "Nothing has been accomplished" may be correct. This is not an unrealistic result since provoking immediate action was not an objective of the study team. However, if one looks at one of the major GTEA objectives, "Providing a base line upon which intelligent, responsible citizens can form judicious decisions concerning the future of their environment," then a very large step has been taken, a "lot of ground covered," and a tremendous potential for action has been provided! The people of Greenwich Township now have access to the most intense environmental study performed in their area. In the near future, as questions arise concerning use of land and water resources, the citizens of Greenwich have a body of impartial facts from which they can draw evidence to support their plans for the future.

In addition to providing a sound benchmark comprised of environmental data, a result of this project was to provide the citizens of Greenwich Township with aid in the form of recommendations for action from impartial laymen and professionals. Instead of waiting for a major environmental disaster, the citizens of Greenwich have the advantage of being forwarned regarding potential hazards facing their environment. They also have the advantage of having a delineation of existing and potential resources. Therefore, by considering some of the recommendations of the GTEA team, the concerned and alerted citizens can take their own steps to guarantee the survival of a safe, healthful environment in

Greenwich Township.

What does the GTEA team recommend as a result of this project? The following are statements of recommendation from the individual reports contained in the preceding pages: (before passing judgement on these recommendations, the reader should read the text of the reports in order to learn from what facts these recommendations arose).

From the Historical Analysis: "...at least three sites warrant special consideration for historical preservation and restoration -- the cluster of buildings and a covered bridge (1869) at Dreibelbis Station and nearby Dunkel's Church (founded in 1744 at New Jerusalem) and Stein's Distillery, located near the Three Mile House..." P. Atwell.

From Attitudes to the Environment: "If anything could be said to emerge clearly from this survey of attitudes toward the environment in Greenwich Township, it is that residents are concerned and that they wish to be consulted with regard to future decisions. From this emerges the single recommendation of this report, that machinery be established by which the citizenry can be consulted on major land use and development decisions." A. Dixon.

From the Botanical Analysis: (Dr. Halma lists nine recommendations. For the sake of brevity only two are included in this SUMMARY).

"In consideration of the inputs available, the following broad recommendations are made:

1. Serious consideration be given to retaining as much of the wooded land intact as possible.
2. Wooded areas having a distinctive character or flavor, as the scattered evergreen stands (as in the Dietrich Bridge area), should be retained and/or carefully managed. They add a pleasant variety to the predominatly hardwood forest environment." J. Halma.

From the Analysis of Fish Life: "It is suspected that unless there are toxic trace elements in the streams this sparsity in distribution and the small size of all fish is directly related the lack of adequate protection. It is the opinion of this author that both streams could be greatly improved simply by the construction of rock riffles and baffles. These obstructions would afford much needed hiding places for fish." J. Bahorik.

From the Wildlife Analysis: "...Possible future studies are suggested and a list of area which should be preserved as wildlife refuges is indicated. These areas include the (flood plains along the Sacony and Maiden Creeks) the northwest corner of the township along the Kittatiny Ridge, the area around Camp Edmar, and areas north and northeast of State Game Lands No. 182. In our opinion, individual land owners can do much to provide suitable habitats for wildlife by maintaining wooded sections, marshes, farm ponds, etc. on their properties and planting appropriate trees and shrubs to attract wildlife." R. Gray and C. Oplinger.

From the Population Analysis: "One main attitude that arose from this analysis is the concern over haphazard development of the township." P. Duddy.

From the Solid Waste Analysis: ..."The majority of the open dumps appear to be inactive although two persistent problems seem to exist. One problem is the apparent dumping at the side of the road by passing vehicles and the second and more prominent is the large auto graveyard sites that remain active in the township.

The committee encourages the concept of recycling as a primary consideration for the residents of the township and landfill as a second but less desirous method." T. Schmoyer.

The GTEA study team thus sees Greenwich Township as a unique area relatively undamaged by the hand of man yet capable of supporting man along with other forms of animal life and a great variety of plants. It is an area in which man can live in good health and happiness in a clean environment so long as he protects and carefully manages his natural inheritance. There are signs of erosion of quality as indicated by the recommendations and findings of the reports. However, the erosion can be stopped and quality of the environment preserved. The residents of Greenwich Township are fortunate to be in a position wherein they can help to control and guide the directions of their future. We believe the information obtained through the efforts of the GTEA team will provide a solid stepping stone for both future studies and decisions to be made by the residents of Greenwich Township. It is now a matter for the citizens to utilize these findings as an assist in their deliberations concerning the future of quality environment in Greenwich Township.